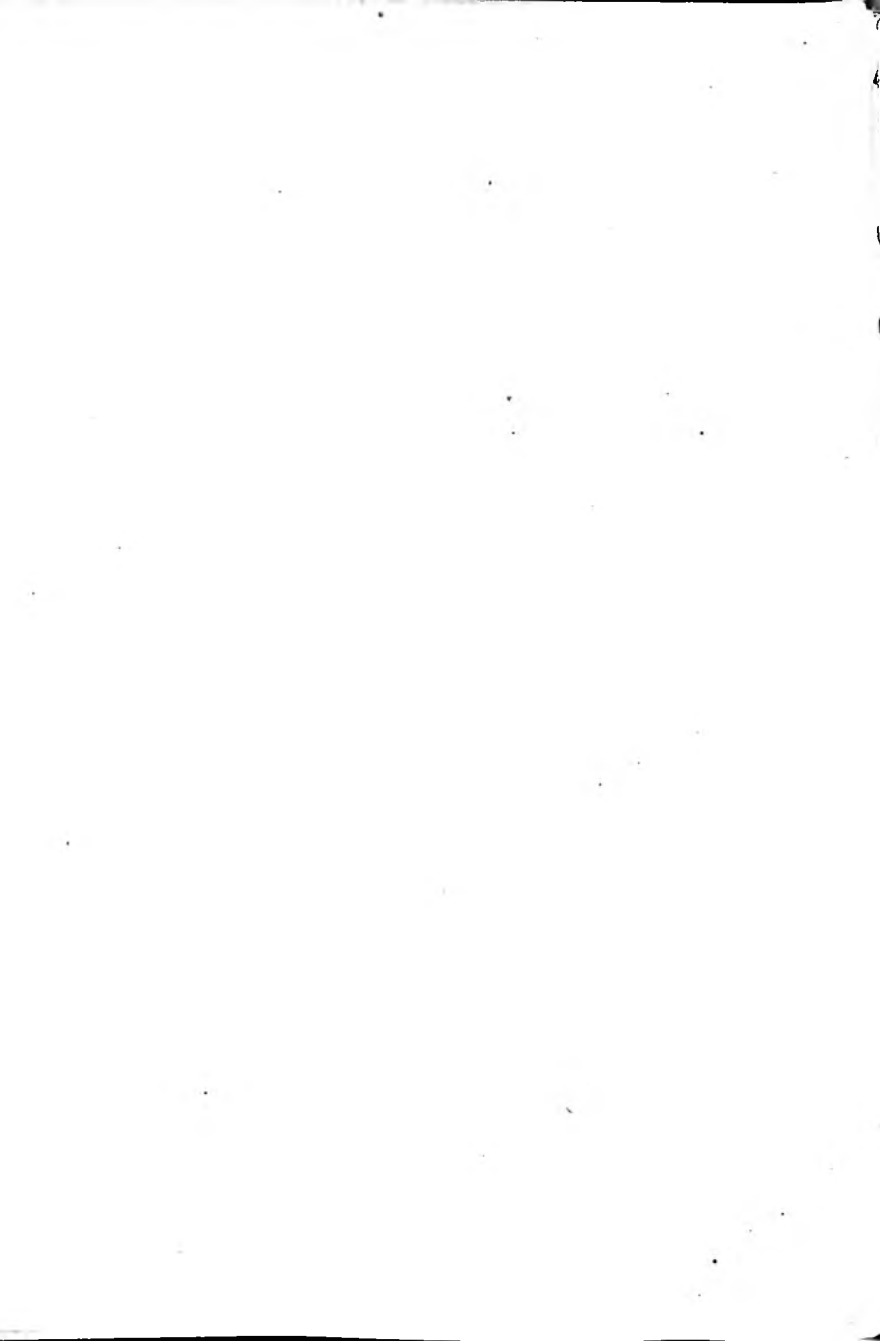


GENERAL INSTRUCTIONS
FOR
HYDROGRAPHIC SURVEYORS.

1915.



NOTICE.

These Instructions are to be carefully studied, and the directions contained in them closely adhered to by all Admiralty Hydrographic Surveyors.

Addenda to these Instructions will be issued as necessary, and will incorporate all memoranda which may be issued from time to time.

By the publication of these Instructions all former editions, as well as all memoranda relating thereto, are cancelled.

*J. F. PARRY,
Hydrographer.*

ADMIRALTY,

MAY, 1915.

(3409). Wt. 33660/338. 500.—6/15. T.G.E.

A2

LIST OF CONTENTS.

	Pages
Section I.—Instruments - - - - -	7-22
„ II.—Books and Stationery - - - - -	23-38
„ III.—The Survey - - - - -	39-58
„ IV.—Draughtsmanship - - - - -	59-74
„ V.—Sailing Directions - - - - -	75-88
„ VI.—Geographical Positions, &c. - - - - -	89-93
„ VII.—Datums Used on Charts - - - - -	94-98
„ VIII.—List of Publications of Hydrographic Department	99-114

LIST OF PLATES.

Plate No. 1.—Uniform System of Marking Lead Lines - <i>To face page</i>	21
„ No. 2.—Surveying Floating Beacon - - - - -	21
„ No. 3.—Examples of Views - - - - -	57
„ No. 4.—Examples of Views - - - - -	57
„ No. 5.—Chart showing System of Colouring - - - - -	62
„ No. 6.—Photographic Reproduction of Coloured Chart - - - - -	62
„ No. 7.—Correct Curvature for Writing on the Fair Chart - - - - -	62
„ No. 8.—Incorrect Curvature for Writing - - - - -	62
„ No. 9.—Names and Styles of Lettering - - - - -	63

PREFACE.

The subjects which demand the attention of the Hydrographic Surveyor are many and various.

First and foremost is a complete survey of the portion of the seaboard allotted as the scene of his principal labours; this in itself involves many considerations.

The formation of an accurate chart is the result of many operations, all demanding great care, attention, and method, and intimately connected with the chart are the numerous notes and observations which form the basis of complete sailing directions.

Tides, currents, winds, and weather must all be continuously and methodically observed.

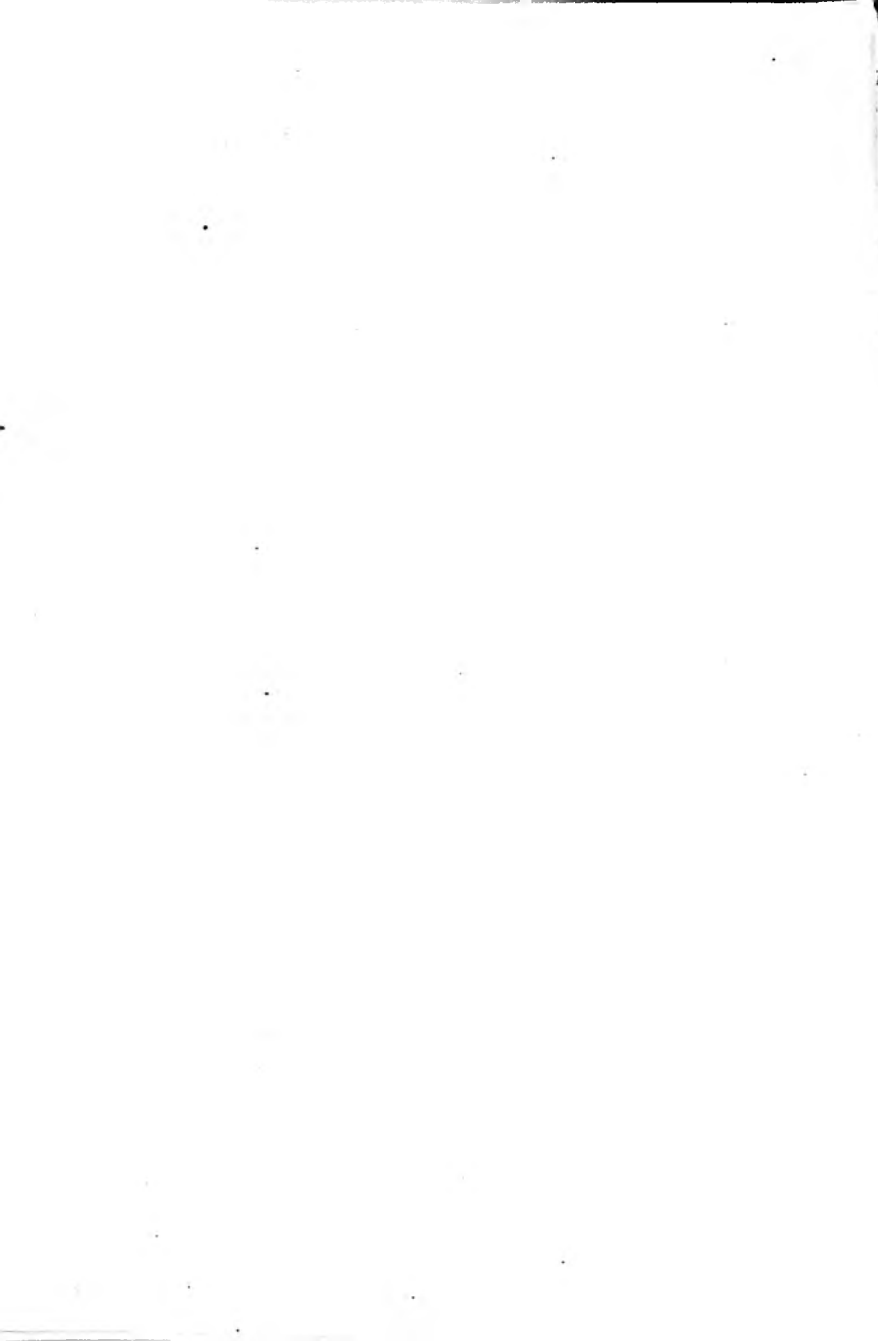
There are, in addition to the above, many matters which, though they may be at present mainly of scientific interest, cannot fail to produce in the future practical results of great interest to the seaman and to the world in general, such, for instance, as deep sea observations of all kinds, depths, temperatures, and specific gravities, all bearing on the important question of oceanic circulation, and without which no complete knowledge of the laws governing climate in general can be attained.

A little geological or botanical knowledge will enable the Surveyor to make many observations of value in the less-known quarters of the globe: such observations will also often be of practical assistance to the Surveyor—thus, the connection between the geological formation above sea level and the contour of the sea bed, if duly considered, will assist him in coming to a decision as to how the sounding work off a coast should be planned.

The Hydrographic Surveyor should therefore, when possible, allow no opportunity of making and recording such special scientific observations to slip.

Method is above all things necessary, and it is essential that all observations, on which the survey itself is founded, are rendered in a uniform manner, in order that the records may be easily consulted, and the value of the survey tested, either now or in the future.

To this end, certain forms and books have been established, which are always to be used and adhered to.



THE ESTABLISHMENT OF HYDROGRAPHIC INSTRUMENTS ALLOWED
TO SURVEYING SHIPS—*continued.*

	Panama.	Nerlin.	Mutine.	Sealark.	Endeavour.	Hearty.	Roscarb.	Triton.	Daisy.	Escher.	Plymouth.
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Drawing instruments:—											
First class - - - - -	1	1	1	1	1	1	1	1	1	1	1
Third class - - - - -	11	11	11	9	10	10	7	7	4	4	5
Field cases - - - - -	10	10	10	8	10	10	7	7	4	4	5
Geological specimens - - - - -	1	1	1	1	—	—	—	—	—	—	—
Heliostat, Galton - - - - -	7	7	7	5	7	7	5	5	1	1	2
Levels - - - - -	1	1	1	1	1	1	1	1	—	—	—
Levelling staves - - - - -	2	2	2	2	2	2	2	2	—	—	2
Magnifying glasses:—											
4-in. - - - - -	1	1	1	1	1	1	1	1	1	1	1
Folding - - - - -	2	2	2	2	2	2	2	2	—	—	—
Tripodial - - - - -	1	1	1	1	1	1	1	1	—	—	4
Measuring tapes:—											
Steel - - - - -	4	4	4	3	4	4	3	3	—	—	4
Linen - - - - -	7	7	7	5	7	7	5	5	1	1	5
Mercury bottles, spare - - - - -	1	1	1	1	—	—	—	—	—	—	—
Microscopes - - - - -	1	1	1	1	—	—	—	—	—	—	—
Protractors, circular, brass:—											
20-in. - - - - -	1	1	1	1	1	1	1	1	—	—	—
Semicircular, brass:—											
18-in. - - - - -	1	1	1	1	1	1	1	1	1	1	1
Protractors, rectangular:—											
Metal, 12-in. - - - - -	1	1	1	1	1	1	1	1	1	1	1
Boxwood, 12-in. - - - - -	7	7	7	5	7	7	5	5	4	4	5
Boxwood, 8-in. - - - - -	11	11	11	9	10	10	8	8	4	4	5
Protractors, Cust's, rolling boxwood:—											
18-in. - - - - -	1	1	1	1	1	1	1	1	1	1	4
12-in. - - - - -	1	1	1	1	1	1	1	1	—	—	—
Rulers, parallel:—											
36-in. - - - - -	1	1	1	1	1	1	1	1	—	—	—
27-in. or 24-in. - - - - -	1	1	1	1	1	1	1	1	1	1	1
18-in. - - - - -	1	1	1	1	1	1	1	1	1	1	1
15-in. or 12-in. - - - - -	2	2	2	2	2	2	2	2	2	2	2
Scales, metal:—											
60-in. or 82-in. - - - - -	1	1	1	1	1	1	1	1	—	—	—
48-in. to 54-in. - - - - -	1	1	1	1	1	1	1	1	1	1	1
36-in. - - - - -	1	1	1	1	1	1	1	1	1	1	2
24-in. - - - - -	1	1	1	1	1	1	1	1	1	1	4
Scales, ivory or boxwood - - - - -	1	1	1	1	1	1	1	1	1	1	1
Sextants, observing:—											
New pattern - - - - -	2	2	2	2	—	—	—	—	—	—	—
Old pattern - - - - -	2	2	2	2	2	2	2	2	1	1	—
Stellar - - - - -	2	2	2	2	2	2	2	2	1	1	—
Sextants, sounding:—											
New pattern, 6-in. - - - - -	4	4	4	3	3	3	3	3	3	3	4
New pattern, 5-in. - - - - -	4	4	4	3	4	4	3	3	1	1	1
Old pattern - - - - -	4	4	4	3	4	4	3	3	—	—	—
Sextants, pocket:—											
New pattern - - - - -	3	3	3	3	3	3	3	3	—	—	2
Sextant stands:—											
New pattern - - - - -	2	2	2	2	—	—	—	—	—	—	—
Old pattern - - - - -	1	1	1	1	1	1	1	1	—	—	—
Station pointers:—											
New pattern, 12-in. - - - - -	1	1	1	1	1	1	1	1	—	—	—
New pattern, 8-in. - - - - -	2	2	2	2	2	2	2	2	2	2	2
New pattern, boats - - - - -	11	11	11	9	10	10	8	8	2	2	5
Cust's, 12-in. x 12-in. - - - - -	7	7	7	5	7	7	5	5	2	2	5
Cust's, 6-in. x 8-in. - - - - -	12	12	12	10	10	10	8	8	4	4	5

THE ESTABLISHMENT OF HYDROGRAPHIC INSTRUMENTS ALLOWED
TO SURVEYING SHIPS—*continued.*

	Fantome.	Martin.	Mutino.	Seclark.	Endeavour.	Henry.	Research.	Triton.	Daisy.	Escher.	Plymouth.
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Star finder, Cust's	-	-	-	-	-	-	-	-	-	-	-
Straight edges:—											
72-in.	1	1	1	1	1	1	1	1	-	-	-
54-in. to 60-in.	1	1	1	1	1	1	1	1	1	1	1
48-in. to 50-in.	1	1	1	1	1	1	1	1	1	1	2
36-in.	1	1	1	1	1	1	1	1	-	-	4
24-in.	2	2	2	2	2	2	2	2	2	2	5
Telescopes, binocular:—											
Prismatic	4	4	4	3	4	4	3	3	2	2	3
Ordinary	4	4	4	3	4	4	3	3	2	2	2
Telescopes, field	2	2	2	2	2	2	2	2	1	1	-
Theodolites:—											
New pattern	8	8	8	6	7	7	5	5	1	1	5
Old pattern	3	3	3	3	3	3	3	3	-	-	-
Thermometers, deep sea	24	24	24	24	6	6	6	6	-	-	-
Watches:—											
Sounding	12	12	12	10	10	10	7	7	4	4	5
Tide	4	4	4	4	3	3	3	3	2	2	5

2. As soon as the instruments are received on board, they are to be compared with the list accompanying them, and examined to ascertain whether any have been damaged in transit, and also to see that each instrument is in thorough working order. Their receipt should then be acknowledged, stating whether they are in good order or if any have been damaged.

3. **Repairs.**—Whenever hydrographic instruments are returned to the Hydrographic Department as worn or damaged, or on the ship being finally paid off, a detailed report on the condition, &c., of each of the more important instruments is also to be forwarded, stating the nature of the defects, if any, and whether, in the opinion of the officer in charge of survey, the instrument is worth repair.

When a detachable part of an instrument requires repair, the whole instrument is to be returned to the Hydrographic Department, except in the case of sextant glasses requiring resilvering in home surveys, when only the glasses need be sent.

When any repairs to chronographs are necessary, the instruments are to be sent direct to the Astronomer Royal, Royal Observatory, Greenwich, the necessary documents, as in the case of other hydrographic instruments, being forwarded to the Hydrographer, in addition to the documents required by the Astronomer Royal. *See* Transmission of Instruments (page 11), and Treatment and Packing of Chronometers, Form H.—112 (page 13).

Storage batteries are supplied with the new pattern observing sextants, and with chronographs, when first supplied from the store; when these batteries become worn out they are to be replaced by local purchase, any single cell storage battery being suitable; the Service

pattern dry cells can also be used. When returning observing sextants and chronographs to store, used batteries are not to be sent with them.

It is, generally speaking, advisable that hydrographic instruments should not be repaired out of England; minor repairs to unimportant parts may, however, be performed by opticians or instrument makers of good repute on the station.

The sounding watches supplied are cheap articles only, and are not worth the cost of repair.

Damaged instruments are to be returned to the Hydrographic Department on the first available opportunity.

4. **Demands.**—A list showing the probable requirements of hydrographic instruments during the ensuing surveying season is to be furnished annually, to reach the Hydrographic Department by the 1st January.

This list is to state in detail whether the instruments are required:—

1. To replace those lost by accident or otherwise.
2. To replace those returned to the Hydrographic Department.
3. Additional to those already on board.

As ships are frequently recommissioned abroad, and it is not known at the Hydrographic Department what their requirements may be for the new commission as regards hydrographic instruments, a list of the probable requirements for the next commission is to be forwarded in ample time for their supply by the date of commissioning, allowing two months for the Department to deal with the demand, in addition to the time necessary for their transmission to the place of re-commissioning.

5. **Losses.**—Losses of any of the more important hydrographic instruments, viz., those bearing H. numbers, are to be reported immediately to the Hydrographer on Form H.—50, with a view to replacement, the fullest particulars of the losses being given.

When deep-sea thermometers are lost while sounding, a notation is also to be made in the deep-sea sounding-book, on the page on which the sounding is entered, and on the page provided for the list of deep-sea thermometers on board, at the beginning of the book; such notations are also to be inserted in the lists of deep-sea soundings, Form H.—37, forwarded from time to time.

Losses of hydrographic instruments are also always to be entered in the ship's log, and the date of such entry stated on Form H.—50.

6. **Care of instruments.**—A most important point is the care of the hydrographic instruments supplied. Certain instruments in general use are allotted to each Assistant Surveyor for the duration of the survey, viz., sounding sextant, station pointer, theodolite, binoculars, box of drawing instruments, &c. The object of this is to familiarise the Surveyor with the particular instruments allotted to him, and to ensure their better preservation, thus tending to the production of better work.

The errors of every instrument are to be at once ascertained by the Surveyor to whom it is allotted, and noted in its box; this operation is to be repeated at frequent intervals. See "Hydrographical Surveying" (*Wharton & Field*), Chapter I.

Every instrument on return from daily service is to be wiped, and, if need be, partially washed with fresh water to remove the salt and keep it in good condition. This is to be done by the Surveyor using the instrument.

Hydrographic instruments have sometimes been returned to the Hydrographic Department whose condition showed that but little care had been bestowed upon them by the Surveyors using them. As the accuracy of the work of a survey depends on the instruments used, it is essential that those supplied should be properly looked after, and, in addition, every instrument is to be thoroughly examined by a senior Assistant Surveyor at least once a year.

7. Instrument account.—Hydrographic instruments are accounted for in the Instrument Account, Form H.—77; the instructions for keeping the account, given on the back of the form, are to be strictly adhered to.

8. Transmission and packing of instruments.—Whenever instruments are returned to the Hydrographic Department for repair or for any other reason, they are always to be accompanied by Form H.—50, and a reference sheet is to be sent under separate cover, stating the mode of conveyance and route by which the package is being sent, and the expected date of its arrival, together with a list showing in detail the contents of the package. A list of contents is also to be placed inside the package, which is to be addressed "The Hydrographer, Admiralty, Whitehall, London," and also plainly marked "Instruments with Care."

Hydrographic instruments, with the exception of those specially mentioned, are never to be packed for transit in cases exceeding 4 feet 6 inches by 2 feet 3 inches by 2 feet 3 inches. Instruments exceeding 4 feet 3 inches in length, viz., beam compasses, scales, straight edges, levelling staves, theodolite legs, &c., are to be packed separately.

The weight of any packing case containing hydrographic instruments is never to exceed 2 cwt.

When packing instruments for transmission, great care is necessary to have them firmly secured in their boxes, without being so wedged up as to cause injury by too much pressure on the more delicate parts. Sufficient space must be allowed between the instrument boxes and the packing case for a cushion of paper, wood shavings, &c. *Sawdust is not on any account to be used for this purpose*, as it invariably finds its way into the instrument boxes, and causes much damage.

9. **Meteorological instruments** will be drawn from the Naval Store Officer of a Dockyard according to a list sent from the Hydrographic Department. Replacements can be made by demand on any Naval Yard. When no longer required on board they are to be returned to store at a Dockyard.

10. **Chronometers.**—Care and treatment.—These instruments, on which so much of the accuracy of the Surveyor's work depends, must be treated with the greatest care.

Though the chronometers supplied to the Navy are carefully selected as being properly compensated for changes of temperature, every effort must be made to prevent unnecessary variations of heat and cold; damp must be excluded, and a sheet of fearnought laid over the chronometers, with flaps cut over each, will be found to conduce to this end, and also to assist in comparison by ear, by deadening the sound of those not under observation.

It is important that the winding should be performed, as far as possible, by the same person at the same hour, as the speed at which a watch is wound affects its rate in many instances when the maintaining power is not perfect.

In handling pocket chronometers care must be taken not to give them any circular or oscillatory motion, whether in winding or carrying; and they must always be kept out of the sun. See "Hydrographical Surveying" (*Wharton & Field*), page 46. See also "On the Supply, Use, and Treatment of Chronometers, Watches, and Hack Watches," Form H.—112, on page 13.

11. **Chronographs** are now being supplied to enable chronometers to be accurately compared, and specially for use in connection with meridian distances; they are hydrographic instruments, and are, therefore, to be accounted for in the Instrument Account, Form H.—77. See par. 13, Repairs.

12. **Supply.**—Chronometers and chronometer watches are supplied from the Royal Observatory, Greenwich, on demands approved by the Hydrographer. Care is to be taken to demand other chronometers in lieu of those whose rates become unreliable, and also to replace those which become due for return to the Royal Observatory for cleaning. Replacements abroad may be made from a Chronometer Dépôt in one of H.M. Dockyards when time does not permit of replacement from England.

13. **Repairs.**—Chronometers are not to be placed in the hands of a watchmaker abroad. It is always desirable that each maker should readjust his own instruments, and great harm has sometimes been done to these valuable instruments abroad.

14. **Return to store and transmission.**—Chronometers and chronometer watches are to be returned to the Royal Observatory, Greenwich, on being replaced by others, or when the ship is finally paid off, *i.e.*, not re-commissioning. Strict attention is to be

paid to the directions given on Form H.—112, page 13 as to their packing and transmission. When despatched from abroad they should, if possible, be transmitted through the Chronometer Dépôt of one of H.M. Dockyards.

A list of the chronometers supplied, with particulars of their disposal, is to be kept on the pages provided at the beginning of the Chronometer Journal, H.—63, and the Annual Return of Chronometers, H.—154, is to be rendered on December 31st each year. See also List of Returns, page 36.

15. On the supply, use, and treatment of chronometers, watches, and hack watches.—Form H.—112.

CLASSIFICATION, USE, &C.

Three classes of time-keeping instruments are supplied to H.M. ships, viz., chronometers, chronometer watches, and hack watches.

Chronometers are supplied to H.M. ships in accordance with the nature of the work on which they are likely to be employed.

A special case in which to keep chronometers is usually provided by the Constructor's Department when the ships are fitting out. Chronometers should be placed in this special case, or some other provided for the purpose, in a part of the ship which is as free as possible from vibration, or from any likely cause of undue moisture, and as far as possible from stray magnetic fields.

If any trace of moisture is at any time found on the glass cover, it should be removed by wiping carefully with a cloth.

The wooden lids of the chronometer boxes may be removed, but must always be kept ready at hand to be replaced.

Chronometers should never on any account be moved from their positions for taking observations or any other purpose, hack watches being specially supplied for such purposes.

X. *Chronometers* are supplied only for instructional purposes.

Chronometer watches are supplied to the smaller class of H.M. ships in lieu of chronometers, and are to be placed in the special case provided for the purpose, as in the case of chronometers.

They are delicate and expensive instruments, and if properly treated give results equal to those of chronometers.

They are fitted in boxes that enable them to be wound without removal therefrom.

They should never on any account be moved from their positions for taking observations or any other purpose, hack watches being specially supplied for such purposes.

Hack watches are supplied for conveying the time from the place of observation to the chronometers or chronometer watches or vice versa.

When not being used for this purpose they are to be kept in the chronometer case.

They are less expensive instruments than chronometer watches, but are sufficiently reliable for the purpose for which they are supplied.

WHEN UNFIT FOR SERVICE.

Chronometers and chronometer watches are to be considered unfit for service if:—

- (a) They are broken down or damaged.
- (b) They have run for 4 years since the date of issue from the Royal Observatory, which is shown on the label pasted inside the box.
- (c) They have a daily rate of over 6 seconds.
- (d) They have an irregular daily rate.

Hack watches are to be considered unfit for service if their daily rate exceeds 7 seconds.

Chronometers, chronometer watches, and hack watches which have become unfit for service, should be exchanged at a chronometer dépôt when possible. If this cannot be done they should be packed and dispatched direct to the Astronomer Royal, Royal Observatory, Greenwich, and a new one, to replace, demanded direct from the Hydrographer, the reasons for the return being fully stated.

Damaged chronometers or watches will not be accepted at a dépôt unless accompanied by a copy of the report, which must be rendered to the Hydrographer in all cases of damage, in accordance with Article 1,010, paragraph 6, of the King's Regulations and Admiralty Instructions.

For establishment of chronometers and watches for all classes of H.M. ships and vessels, *see* form H. 110.

UNPACKING AND STARTING.

To Unpack and Start a Chronometer.

Carefully remove the packing and dust inside the wooden box before taking the wrapping of thin paper from the chronometer. Find the packet of screws which fix the gimbal ring to the wood box, then unscrew the glass face, grasp the brass case at the base with the right hand, and place the fingers of the left carefully round the edge of the metal face.

Now turn the chronometer over until it falls gently out of its case into the left hand. If it sticks at all, it can be pushed out by inserting the key and gently bearing down.

Remove the cork wedges from underneath the balance wheel by drawing them out in a parallel direction with the plate. Whatever pressure is exerted should act on the plate, not on the balance. Screw on the glass face. This operation should not start the chronometer. Screw the gimbal ring on to the chronometer, taking care that the slit for the locking apparatus is in its correct position. Then take hold of the chronometer with the left hand, the thumb being on the face and the fingers on the base, inclining it sideways in its gimbal ring, and screw it in its correct position in the wood box. The chronometer is now ready to be started at any required time by a circular motion being communicated to the box.

To start a chronometer watch or hack watch, open the case, cut off the bent narrow end of the paper through the balance wheel and then withdraw the remainder of the paper.

If the bent end of the paper is not cut off it is apt to damage the balance wheel as it is withdrawn.

It is not considered desirable to place chronometers and watches in the hands of local firms for the purpose of adjusting and starting.

PACKING AND TRANSMISSION.

Several instances have occurred of chronometers having arrived at the Royal Observatory either ruined or very materially injured from defective packing; the attention of officers is therefore directed to the careful packing and transmission of chronometers. The following instructions on this subject have been framed by the Astronomer Royal:—

- I. Take the brass case containing the chronometer out of its gimbals, unscrew the glass face, and remove the chronometer from its brass case. Secure the balance with two thin wedges of cork (care being taken that the cork is thoroughly dry) placed near to the cross bar, between the balance and the plate, so as to prevent any movement of the balance, but do not jamb the wedges in. Replace the chronometer in the brass case, screw on its glass face, but do not put it again in its gimbals. Take out the screws which fix the gimbal ring to the wood box; wrap the screws, with their circular brass nuts (if any), in paper; and lay the packet at the bottom of the wood box. Place a little stuffing, such as dry oakum, free from dust, or dry paper shavings, free from dust, or any other dry, clean, and soft material; wood shavings being objectionable, as sometimes containing turpentine and dirt. Lay the gimbal ring upon the stuffing, seeing that the screws and nuts (if any) in the gimbal ring, used for fixing the chronometer to the ring, are screwed home. Place on the gimbal ring some more stuffing, then lay in the brass case containing the chronometer, first wrapping a sheet of thin paper round it to prevent contact with the stuffing material. Fill the space between the brass case and wood box with stuffing, around the brass case, below it, and above it, up to the glass lid of the wood box.

To secure the balance of a chronometer watch or hack watch, a strip of thin dry paper, long enough to protrude outside the case should be drawn through the balance wheel.

- II. Having closed the wooden chronometer box, it is to be placed in a wicker basket or hamper, or in a box of partially yielding character, and is to be packed therein (but not too tightly) with abundance of soft stuffing. If there is

no wicker basket at hand, or nothing except a wooden box, this box must be surrounded with a large quantity of stuffing and enclosed in canvas, so that it can never receive a jarring blow. *It is of the greatest importance that the outside of the packing case be soft and yielding.* When a wooden box is used, the lid of the box should be fixed by screws.

NOTE.—In order to guard against chronometers or watches being extracted from the hampers containing them, without removing the seals or cutting the cords, the lids should be secured by middling the cord and knotting it round the edge of the lid and the hamper, then crossing the parts and knotting them again in a similar manner at short intervals, the ends being finally sealed down on a card tacked to the lid of the hamper. Some short tiers should also be used.

In the case of a long hamper containing two or more chronometers, two pieces of cord should be used, working from the hinge on either side, the ends of each cord being separately sealed, as before, near the middle of the front of the hamper.

- III. Two or more chronometers secured from injury in their boxes (as explained in I.) may be packed in a yielding case or basket, but all contact between them must be prevented by the use of straw or some stuffing material (as mentioned in II.).
- IV. Address the package to the Astronomer Royal, Royal Observatory, Greenwich, in characters distinctly legible, adding the words "Chronometers, with Care." When transmitted from *abroad*, add to the address "c/o Naval Store Officer, West India Docks, London," also, the name of the ship or channel by which it goes to England. When forwarded from a port in the United Kingdom, state by which railway, and send by a mail or passenger train, *but never by a goods train.*
- V. In transmitting chronometers by steamer, cabin freight should, when it can be arranged with the agent, be obtained. The courtesy of the captain in command of mail steamers will frequently permit packages of chronometers being placed in the mail room for greater safety; but chronometers are never to be shipped as mails, as not only is full postage by weight then charged, but the package may be treated as a bag of letters, and receive injury.

Chronometer watches and hack watches may be sent by post.

VI. When a package is sent to the Astronomer Royal, it should have on the outside some evidence as to where it was despatched from, and a letter should be sent by post to the Astronomer Royal giving the contents of the package, with makers' names and numbers, and the route by which sent.

16. Chronograph.—The chronograph being a delicate instrument, care should be taken in handling it, and if being used in the field a tent or screen must be used to protect it from the weather.

The principal features of the Lindquist chronograph are as follows:

- a. A fine clockwork movement whereby a paper tape is run uniformly over a brass table or anvil.
- b. A tape-holder, from which the tape is run.
- c. Two sets of electro-magnetic coils, which, acting on armatures, provide the means of working brass levers or tappers. At the end of each lever is a pin which, in descending, punctures a small hole in the moving tape.
- d. A chronometer is fitted with contacts acting every two seconds, a current being thus sent through one of the coils causing the pin on the corresponding lever to make a puncture in the tape, the chronometer thus recording alternate seconds on the tape.
- e. A touch piece, whereby an observer can record his observations on the tape, through the second tapper.
- f. A storage battery to work both tappers, usually two accumulators, each of an E.M.F. of two volts; it is to be noted that if one cell will work the chronograph there is no need to use the second.
- g. A scale for reading the punctures.
- h. On no account must the ribbon of paper, which receives the impression of the needle, be subjected to any strain by being pulled or wound up as it unreels; it has been found by experience that the most satisfactory method of receiving the paper is to place the chronograph on a table with a deep box alongside it, allowing the paper to fall into it as it unwinds.

17. Remarks on working the chronograph.—

- a. The chronograph movement is enclosed in a brass case with a glass top. It requires very little oiling, and if it is apparently running badly do not oil it before ascertaining—
 - (a) Whether the tape runs freely from the wheel.
 - (b) Whether it passes freely between the jaws of the lead-way on the brass table or anvil.
 - (c) Whether the needle-spring is pressing unduly.
- b. If the tape is pinched on the wheel it can be relieved by the three adjusting screws near the hub.

If the jaws pinch the tape, it can be rectified by adjusting one jaw or cheek; it will be noticed that the screws on this cheek work in slots.

The tape is held down on the table or anvil by a small needle-spring, which has a limited adjustment, and if pressing too hard it tends to stop the free going of the clock movement.

- c. Another arm of the lever carrying the needle-spring is supplied with two small rollers which drag the tape through the lead-way, and both rollers should be working.
- d. The rate at which the tape moves is adjustable. The adjustment to any required speed is made by turning the squared arbor (near the winding arbor), a key being provided for this purpose. A good speed is about one inch of tape running to two seconds; that is, the distance between two consecutive chronometer beats or punctures should be about one inch for general purposes. The chronograph should not be used until it has been running for one minute.
- e. The chronograph can be wound and its rate adjusted without removing the cover, the keyholes being at the side of the cover.
- f. The chronograph can also be started or stopped by means of one of the small ivory handles without removing the cover.
- g. The second ivory handle is to switch the electric current on or off the chronometer.
- h. The chronograph connections are made on the inside by the mere fact of placing the chronograph on the box, two brass handles being fixed on the wood base for this purpose.
- i. There are four terminals on the outside of the box, and these are to be joined up to the battery, the chronometer, and the touch piece, in accordance with the plan which is in the lid of the box, the necessary wires being supplied.
- j. The chronometer current passes through one coil, the observation current through the other. These coils attract armatures which cause the long brass levers or tappers to descend, and the pin fixed in the extremity of each punctures the tape.
- k. The adjustment of the lever should be such that when pressed down slowly by hand the pin will not make a puncture, the puncture really being made by the throw, and the pin therefore should always have a slight rebound, thus clearing it from the moving tape without waiting for the action of the springs which effect the final return. The pin is, however, hinged, and can have a circular motion in the direction of the moving tape, thus ensuring its freedom from sticking. This hinge or pivot should act freely, a screw-driver being supplied for making the various adjustments.
- l. All the tape records should be dated, numbered, and stored for reference. If new tape is required, it should be demanded from the Hydrographic Department. The old tapes are not required at the Hydrographic Department, and are to be destroyed when finished with.

- m.* Before using the chronograph for observations, it is necessary to practise with it generally, and to establish a system for using identification marks on the paper tape.
- n.* The presence of a second person, when using the chronograph, is indispensable, to keep the chronograph wound (it runs down in about 15 minutes), to mark on the ribbon each even minute and also the beginning and ending of each set of sights, and to note the time of the last sight of each set by the clock in the sight book.

A horn protractor is supplied for measuring off from the ribbon, but as this requires time and care it should be done on return to the ship.

18. Sounding machines, special surveying stores, and appliances.—Supply.—These comprise all stores, sounding machines, &c., other than hydrographic instruments and stationery, which are specially supplied for surveying service, and are not kept as ordinary stores in H.M. Dockyards. A list of these stores is given on Form H.—128.

They are supplied from the Hydrographic Store at Chatham by the Hydrographer's order, and all demands for such are to be made direct to him on Form H.—129, except in the case of ships serving on the China or Australia stations, when certain articles can be supplied from the small stock maintained at Hong Kong Naval Yard and at H.M.A. Naval Yard at Sydney, which can be drawn upon by demand on the Naval Store Officer.

The original supply on the ship first arriving will be made by order from the Hydrographic Department, and the stores will be in the charge of the senior Assistant Surveyor.

19. Accounts.—The account of the receipt and expenditure of these stores is to be strictly kept in the book supplied, H.—125, which is to be rendered to the Hydrographer on the 31st December each year, upon the supersession of the officer in charge of the stores, and on the paying off of the ship, accompanied by receipt and supply vouchers on the prescribed forms and by Expenditure Form, H.—155. Stores of a similar nature obtained by local purchase are also to be taken on charge in the account, and the entries supported by vouchers. Care must be taken to maintain the distinction between these special surveying stores and the additional ordinary stores for surveying service which are included in the warrant officers' establishments and are accounted for in the warrant officers' store accounts.

Losses of special surveying stores are to be entered in the ship's log, and dealt with in accordance with the "King's Regulations and Admiralty Instructions." Any special cases should be reported to the Hydrographer at once, stating the full circumstances.

20. Precautions in securing and handling sounding machines.—All sounding machines, whether in use on board the

ship or in boats, in addition to being secured to their sounding platforms in the ordinary manner by their securing bolts, are also to be secured independently of the bolts by a piece of chain passed round the lower part of the frame and shackled to a bolt in the ship or boat, as the case may be. Before passing a sounding machine in or out of the ship or boat a rope's end is to be made fast to it, care being taken that the other end of the rope is secured.

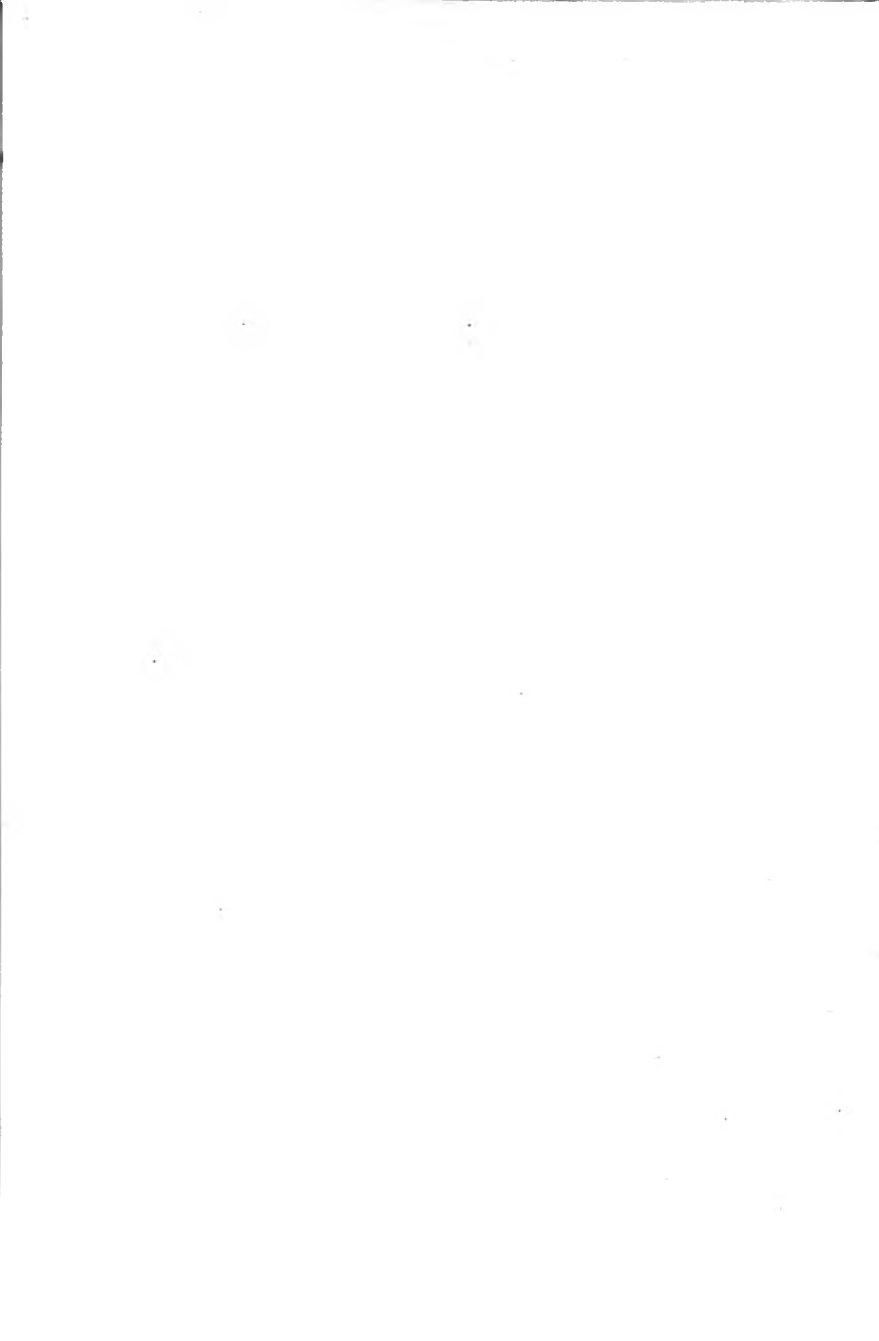
21. Defective sounding machines.—Defective sounding machines are to be returned to Chatham Yard for repairs, and a detailed report forwarded to the Hydrographer stating the nature of the defects.

22. Identification marks on beacons, &c.—All Service materials in use in connection with surveying marks, floating beacons and their moorings, tide poles, &c., which do not already bear any special service marks when received from a dockyard, are to be marked by the ship's artificers as far as possible in some manner to ensure ready identification in case of their improper removal, breaking adrift, &c.

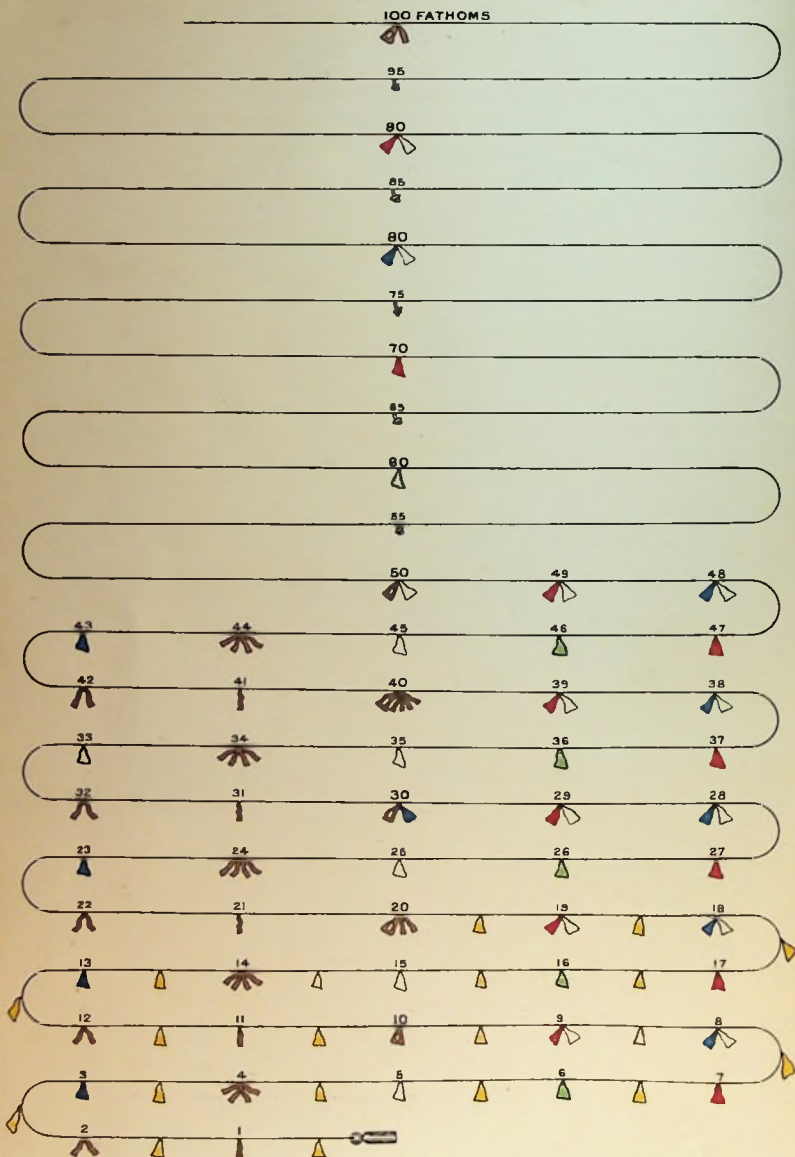
23. Preservation of sounding wire.—Experience has now abundantly shown that galvanising the sounding wire only protects it from rust for a certain time.

To avoid as much as possible the serious loss of thermometers, and other inconveniences which often result from wire parting, the following precautions are to be observed:—

- a.* After a long sounding cruise, with no prospect of the immediate use of the wire, the wire on the drum is to be condemned, so far as deep-sea work is concerned, but it may be conveniently utilised for the boat's machines in shallow-water work.
- b.* When the sounding machine is not in regular use the whole of the wire is to be occasionally reeled off on to one of the spare reels and dried carefully by running through oiled cloths, or cotton waste dipped in hot tallow, during the operation, replacing it on the drum of the machine and oiling it in so doing. This is invariably to be done at the end of every surveying season.
- c.* The wire on the drums of all sounding machines is always to be wrapped round with oiled cloths, and the machines well protected from the weather and salt or fresh water.
- d.* The wire is supplied in hermetically sealed cases. One splice only is allowed in 5,000 fathoms, and a report is to be made if more are found in this length. Such a length is not to be used, and if the wire carries away, leaving a splice in the portion on the drum, it must be unreeled to the splice, which is to be cut off and a new unbroken piece spliced on.



UNIFORM SYSTEM OF MARKING LEAD LINES



Lines (marked as above) to have in addition one knot inserted at every 1, 2, 4 and 5 feet of each fathom, for a sufficient length of line from the lead so as to ensure that at least 40 feet (reduced) may be measured at high water springs.

e.g. given springs rise 27 feet $27 + 40 = 67$ feet, therefore line to be marked in feet to 12 fathoms

24. **Preservation of india-rubber articles.**—The approved method of preserving india-rubber articles, such as waterproof sheets, &c., is to smear them occasionally with pure glycerine.

25. **Marking of lead lines.**—The following system is invariably to be adopted in marking lead lines, both for ship and boat use:—

Marks.	Fathoms.
Leather, one tail - - - - -	1, 11, 21, 31, 41
" two tails - - - - -	2, 12, 22, 32, 42
Blue - - - - -	3, 13, 23, 33, 43
Leather, four tails - - - - -	4, 14, 24, 34, 44
White - - - - -	5, 15, 25, 35, 45
Green - - - - -	6, 16, 26, 36, 46
Red - - - - -	7, 17, 27, 37, 47
Blue and White - - - - -	8, 18, 28, 38, 48
Red and White - - - - -	9, 19, 29, 39, 49
Leather, with hole - - - - -	10
" " " and two tails - - - - -	20
" " " " blue - - - - -	30
" " " " four tails - - - - -	40
" " " " white - - - - -	50
Green - - - - -	60
Red - - - - -	70
Blue and White - - - - -	80
Red and White - - - - -	90
Leather, with hole, and one tail - - - - -	100

In addition to the above marking, every half fathom up to 20 fathoms is to be marked "*Yellow*," and every intermediate 5 fathoms above 50 fathoms is to be marked with "*One knot*."

Lead lines are to have, in addition, "*one knot*" inserted at 1, 2, 4, and 5 feet of each fathom, for a sufficient length of line so as to ensure that at least 40 feet (reduced) may be measured at high water springs: *e.g.*, given spring rise of 27 feet, $27 + 40 = 67$ feet, therefore line is to be marked in feet to 12 fathoms.

The above marking of the lead line is shown in colours on Plate No. 1. Large copies of this diagram, H.—158, are supplied for the information of the officers and ship's company, and are to be exhibited framed, in suitable positions.

26. **Surveying floating beacon.**—The following is a specification of the pattern of surveying floating beacon adopted by the Hydrographic Department:—

Casks.—Two specially-selected 27-gallon casks (half hogsheads tight) with extra thick heads. The heads to be fitted with a filling piece of oak, close fitting, with a joint of white lead; the filling piece to be made level to the chine ends and secured to the head of the cask with five brass screws. The whole to form a watertight joint.

Top and bottom pieces.—The casks to be secured top and bottom by two pieces of yellow pine, best quality. The top and bottom pieces to be checked down one inch over heads of each cask, and secured to filling pieces with four brass screws dovetailed pitch and doweled.

The top and bottom pieces to be fastened together with six $\frac{1}{2}$ -inch galvanised tie rods, nut and screw with saucer heads connecting the pieces together. See Plate No. 2.

The heads of the tie rods should be let in flush for stowage. Size of top and bottom pieces:—

Length 4 feet 10 $\frac{1}{2}$ inches, width 2 feet 1 inch, thickness 4 inches.

(Overlapping the casks entirely for protection.)

A galvanised iron ring, 2 inches wide, $\frac{1}{4}$ inch thick, internal diameter 5 $\frac{1}{8}$ inch, to be secured with four countersunk headed screws to the extreme faces, where pole passes through centre of top and bottom pieces.

Beacon poles.—Best quality, specially selected, free from knots and shakes; extreme length 35 feet, diameter at heel 6 inches, diameter at upper sleeve 5 inches, tapering to 4 inches diameter at head. A hole $\frac{1}{2}$ inch to be pierced through pole 3 $\frac{1}{2}$ inches from the heel end, with protecting washer to prevent chafe of shackle for heel weight. Two galvanised iron sleeves, 12 inches long, $\frac{1}{4}$ inch thick, internal diameter 5 inches, with $\frac{3}{4}$ inch hole for split pin fitting closely to the pole, and secured by one brass countersunk screw in the position as per sketch. Seven inches of the length of the sleeve to project beyond extreme faces of the two top and bottom pieces, to afford better support to the pole.

Heel weights.—Four 56lb. sinkers slung with chain.

Moorings.—Anchors and sinkers as necessary, attached to one length of $\frac{1}{2}$ inch chain, the remainder of moorings of hemp, length according to depth of water.

Mast.—A bamboo, 30 to 36 feet long, is lashed to the part of the pole above the casks, its heel resting on the top piece; this carries a calico flag 12 to 16 feet square.

See "Hydrographical Surveying" (Wharton & Field), page 57.

27. **Mess traps**—Additional mess traps for the use of boat and camping parties detached from H.M. surveying ships are to be drawn by the Accountant Officer as required from the Victualling Yards.

The maximum establishment allowed to a surveying ship, for the use of detached parties, is as follows:—

Mugs, enamelled iron	...	...	...	36 in number.
Plates	"	"	...	36 " "
Knives	...	...	...	24 " "
Forks	...	...	...	24 " "
Spoons	...	...	...	24 " "
Kettles	...	...	...	6 " "
Frying pans	...	...	...	6 " "
Saucepans	...	...	...	6 " "

The articles are to be retained on the Accountant Officer's charge, and not shown in the surveying store account, condemnations and replenishments being made in the usual way.

Technical drawing of a 35-foot pole with various components and dimensions. The drawing includes a side view of the pole with a Beacon Pole at the top, a Galvanized Iron Ring, and a Filling Piece. The pole is 35' 00" long. The Beacon Pole is 5' high. The Galvanized Iron Ring is 4' 10" high. The Filling Piece is 1' 7 1/2" wide. The pole has a 3/4" hole for a Split pin. The pole is made of Galvanized Sleeves. The drawing also includes a detail of the Beacon Pole, a detail of the Galvanized Iron Ring, and a detail of the Filling Piece. The Beacon Pole detail shows a 5' height and a 5" diameter. The Galvanized Iron Ring detail shows a 4' 10" height and a 1' 7 1/2" width. The Filling Piece detail shows a 1' 7 1/2" width and a 3/4" hole for a Split pin. The drawing also includes a detail of the pole with a 3/4" hole for a Split pin. The pole detail shows a 35' 00" length and a 3/4" hole for a Split pin. The drawing also includes a detail of the pole with a 3/4" hole for a Split pin. The pole detail shows a 35' 00" length and a 3/4" hole for a Split pin. The drawing also includes a detail of the pole with a 3/4" hole for a Split pin. The pole detail shows a 35' 00" length and a 3/4" hole for a Split pin.

Beacon Pole
5'

4' 10"
Galvanized Iron Ring

1' 7 1/2"
Filling Piece

Head of Cask (special thickness)

2' 11"

2' 1"

23"

7"

23"

5"

2' 2 1/2"

3/4" hole for Split pin

2' 2 1/2"

3/4" hole for Split pin

5"

5"

35' 00"
POLE

Galvanized Sleeves

12"

3/4"

External Diameter 4' 5 1/2"

NOTE
To be cut on Top & Bottom Piece Size 2". Depth 1/4"

1' 7 1/2"

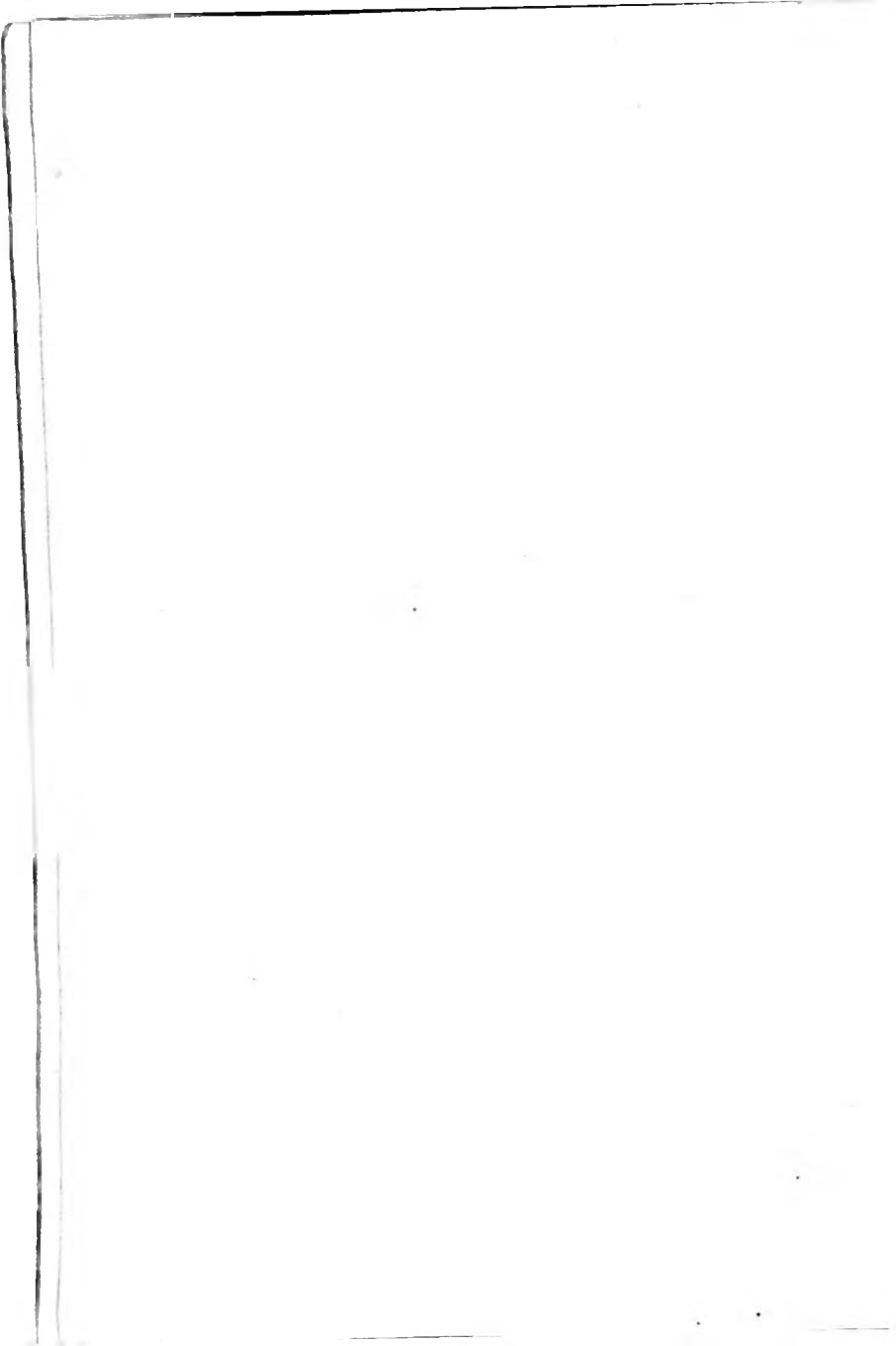
Galvanized Iron Ring

5 1/8"

23"

NOTE

↑ To be cut on Top & Bottom Piece
Size 2". Depth $\frac{1}{4}$ "



SECTION II.

BOOKS AND STATIONERY.

Books.—Each Assistant Surveyor is supplied with (a) a Field Book for use in shore work, *e.g.*, coastlining, topography, &c.; (b) a Sounding Book, for recording soundings obtained from boats; (c) a Sight Book, for recording astronomical observations taken on shore and at sea; and (d) a Surveying Sketch Book, H.—12, for use either on shore or on board the ship.

All books, whether rough or fair, are to bear their titles outside, with the name of the ship, the dates, and the name of the survey; the special label, H.—44, supplied for the purpose, is also to be pasted inside the front cover of every book and filled in.

In the case of an Assistant Surveyor's Field Book, Sounding Book, &c., his name is also to be given outside, thus:—

Endeavour—1912-13.

Lieut. C. W. Tinson.

Field Book.

Home Survey.

The special label, H.—44, also being pasted inside the front cover, as before mentioned.

The above is most important as a means of future reference.

1. Field Books, Sounding Books, &c.—All observations and notes are to be recorded in these books, and the necessity for noting clearly every fact of value cannot be too strongly insisted upon; nothing must be left to memory.

A date (day of the week, day of the month, month, and year) and the locality are to be inserted at the commencement of every day's work.

In recording astronomical observations in the Sight Book, the various forms used in "Hydrographical Surveying" (*Wharton and Field*), are to be employed.

The method of recording soundings, angles, and observations is in all cases to be the same in every survey. Nothing is more confusing to the officer who may have to use the books of others than a diversity of practice in entering the data.

The ordinary symbols should be used, as tending to brevity, but no others are to be employed without the sanction of the Officer in charge of the Survey. See "Hydrographical Surveying" (*Wharton and Field*), page 378.

The above mentioned books are to be forwarded to the Hydrographic Department on the completion of the survey.

2. **Main Angle Book**, H.—157, is to be kept in accordance with the instructions therein. All accepted angles obtained at stations for the purposes of plotting main and other points are to be entered in this book. When a false station has been made, the angles as observed, and the corrected angles, are to be shown in the separate columns provided.

This book is of great service during the progress of a survey, and is to be forwarded to the Hydrographic Department on the completion of the survey, it being a most valuable record in connection with the work.

3. **Surveying Sketch Book**, H.—12, is to be kept in accordance with the instructions contained therein and is to be forwarded on the completion of the survey.

4. **The Deck Book**, H.—85, is to contain ship's soundings, angles obtained from the ship when used as a station, elevations of the land from ship's positions, and all other matter obtained from the ship herself, for which special books are not provided. It is to be forwarded to the Hydrographic Department on the completion of the survey.

5. **Deep Sea Sounding Books**, rough, H.—145, and fair, H.—144, are to contain the details of deep casts. Soundings are to be numbered consecutively during each year.

The list of deep-sea thermometers on board, with their individual corrections, is to be entered on the pages provided at the beginning of the fair book; the fair book is to be forwarded to the Hydrographic Department on paying off, but the rough book is to be destroyed when finished with.

Loose forms, H.—37, are also supplied for transmission to the Hydrographer as necessary. See page 36.

6. **Surveying Data Book**, H.—149, is to contain all the essential results obtained during the survey, as follows:—

- a. A copy of each Meridian Distance Return, H.—152.
- b. A copy of each Latitude Return, H.—153.
- c. A copy of each Variation Return, S.—385 and S.—386.
- d. A record of each base measured, giving full details.
- e. A copy of each triangulation scheme.
- f. Records of all true bearings.
- g. A record of errors of chronometers by different observers when obtaining meridian distances.
- h. Tidal data.—Full information as to datums and their connection with permanent marks on shore, or ordnance or other established bench marks where possible. The connection between zero of tide pole and the datum used in the survey is invariably to be given.

- i. Any other important data obtained which may be useful to record for service during the progress of the survey, and afterwards as a permanent record in the Hydrographic Department.
- j. A register of the receipt and dispatch of all hydrographic information, hydrographic instruments, original documents, &c., and the date of their acknowledgment by the Hydrographic Department.

This book is to be kept in accordance with the instructions therein, and is to be forwarded to the Hydrographic Department on the completion of the survey or on the ship being finally paid off.

7. **The Height Books**, H.—141 and H.—142, are to be carefully kept, and every angle of elevation and depression observed and recorded in H.—141, the book supplied for "Calculations," stating whether taken with sextant or theodolite. In the book for "Means of Heights," H.—142, all the results for each elevation are to be recorded, also stating whether sextant or theodolite, the distinctive names used during the survey being supplemented by detailed descriptions to ensure future identification of the various summits, &c. Both books are to be forwarded to the Hydrographic Department on the completion of the survey.

8. **The Chronometer Comparison Book**, H.—64, supplied by the Hydrographic Department, is to be used and correctly and completely filled in. As this book is not required for record purposes in the Hydrographic Department, it is to be destroyed when the Chronometer Journal, H.—63, concerned, is forwarded.

9. **The Chronometer Journal**, H.—63, as supplied by the Hydrographic Department, is to be kept as a permanent record. In accurate meridian distance work the information afforded by the inter-comparisons here recorded is of great value, enabling the erratic behaviour of any chronometer to be promptly detected. The record of rates at the end of the book is to be strictly kept; regarded as a record for the Hydrographic Department, these rates form the most valuable part of the book.

A page at the beginning of the book is provided for a list of chronometers and deck watches supplied and particulars of their disposal.

The Chronometer Journal is to be returned to the Hydrographic Department on paying off.

10. **The Tide Journal**, H.—143, is to be kept in the form supplied, and in accordance with instructions therein; it is to be returned to the Hydrographic Department on the completion of the survey.

11. **Tide Journal Sheets**, H.—65, similar to those contained in the Tide Journal Book, are supplied for general use in the survey.

12. **The Register of Tides, H.**—15, gives the time and height of high and low waters observed, and is to be filled in from the Tide Journal whenever continuous observations extending over one lunation or more have been obtained. All information with regard to datum, mean sea level, &c., is to be given in the register in the place provided. The Register of Tides is to be kept in accordance with the instructions therein and forwarded to the Hydrographic Department with the fair chart of the locality.

13. **Tidal Diagram Book, H.**—160, is supplied to contain a record of tidal curves observed during the progress of the survey for the information of the officer in charge. It is to be kept strictly in accordance with the instructions printed therein, and is to be destroyed on the completion of the survey.

14. **Tidal Diagram Sheets, H.**—147, similar to those contained in the Tidal Diagram Book, are supplied for plotting curves for the information of the assistants, and for general use in the survey.

15. **Record of Tide Pole Readings, H.**—148, is to be kept in accordance with instructions therein. This book is to be destroyed when finished with.

16. **The Current Book, H.**—146, is to contain the observations for the direction and rate of the tidal streams and currents observed from the ship or boats at anchor. It is to be kept in accordance with the instructions therein and forwarded to the Hydrographic Department on the completion of the survey.

17. **Orthography Book.**—It is convenient, in some surveys, to keep a foolscap book in which all native names of natural and other objects as obtained by the different surveyors are entered.

The difficulty of understanding natives, and the difference in clearness of pronunciation by the natives, together with the differences in appreciation of the sound by different Surveyors, often leads to very erroneous names being placed upon the chart, but if the various versions are collected together, the Officer in charge of the Survey can compare the different names collected, and, if necessary, correct the orthography according to the Admiralty rules before they are finally accepted. See Section V. This book being only intended for the convenience of the Officer in charge of the Survey is not to be forwarded to the Hydrographic Department.

18. **Special label, H.**—44.—Attention is drawn to the directions on page 23 respecting the use of the special label, H.—44, supplied for pasting inside the front cover of *every* book in which surveying data is recorded.

19. **Meteorological Logs.**—All surveying ships are to keep a meteorological log when on passage or on their surveying ground, unless the latter is in the immediate vicinity of an established meteorological station. On these books a large part of the data on which

wind and current charts are founded are based, and it should be a special point to make them as complete as possible. Both to the Hydrographic Department and to the Meteorological Office they are of great value. The existing meteorological charts are generalisations too wide in their scope of time to be true guides, and as there is no doubt that all the essential data of winds, currents, and temperature vary greatly in every locality in each successive month, a sufficiency of observations to enable monthly charts to be compiled or improved is much to be desired.

The information in the meteorological log is to be as complete as possible. Notes on the movements of the clouds in the upper regions of the atmosphere are especially needed.

During any cyclonic disturbances, whether the wind approaches hurricane force or not, continuous records, especially of barometric changes, are to be constantly recorded.

Barograph records, with dates and geographical positions, are to be pasted in the fair meteorological log.

Rough and fair meteorological logs are supplied by the Meteorological Office on request; they are to be forwarded to the Director, Meteorological Office, South Kensington, London, S.W., when they contain four months' or nearly four months' observations.

20. **Packing of books.**—The size of packing cases containing books is never to exceed 2 feet 3 inches in length, width, or depth. See page 29 for transmission.

21. **Hydrographic books for reference.**—The following books for professional reference will be supplied from the Hydrographic Department for the chart-room library of each surveying ship:—

- *1. "General Instructions for Hydrographic Surveyors."
2. "Hydrographical Surveying." (*Wharton and Field.*)
3. "Nautical Surveying." (*Shortland.*)
4. "Manual of Spherical and Practical Astronomy." (*Chauvenet.*)
5. "Mathematical Instruments." (*Heather.*)
6. "Surveying Instruments." (*Stanley.*)
7. "Notes on Management of Chronometers." (*Shadwell.*)
8. "Greenwich Catalogue of Stars."
9. "Cape Catalogue of Stars."
10. "Index of 800 Stars." (*Somerville.*)
11. "Star Atlas," large. (*Proctor.*)
12. " " " small. (*Proctor.*)
13. "Logarithms of Sines and Tangents to every Second." (*Shortrede.*)
14. "Manual of Logarithms." (*Bruhn.*)
15. "Table for Facilitating Calculation of Heights," large. (*Purey-Cust.*)
- *16. "Tables for Facilitating Calculation of Heights," small. (*Purey-Cust.*)

* A copy is also supplied to each Surveyor and Recorder.

- †17. "Table of Chart Scales with their Corresponding Natural Scales." (*Powell.*)
- †18. "Table of Meridional Parts for the Terrestrial Spheroid." (*Atherton.*)
- †19. "Spheroidal Tables." (*Carrington.*)
- †20. "Tables for Determining Geodetic Positions and Use of Co-ordinates." (*Atherton.*)
- †21. "Table for the Graduation of Surveys and Charts on the Gnomonic Projection." (*Hydrographic Department.*)
- †22. "Tables for Great Circle Sailing and their Application to the Construction of a Gnomonic Chart." (*Towson and Atherton.*)
- †23. "Table for Converting French Mètres into English Feet and Fathoms." (*Carrington.*)
- †24. "Table of Chords." (*Douglas.*)
- †25. "Tables for converting arc into time and vice versa."
- 26. "Directions for Reducing Tidal Observations." (*Burdwood.*)
- 27. "The Tides." (*Darwin.*)
- 28. "Practical Manual of Tides and Waves." (*Wheeler.*)
- 29. "Gulf Stream Investigations." (*Pillsbury.*)
- 30. "Report on Currents of Dardanelles and Bosphorus." (*Wharton.*)
- 31. "Elementary Meteorology." (*Scott.*)
- 32. "Weather Charts and Storm Warnings." (*Scott.*)
- 33. "Principles of Forecasting." (*Abercrombie.*)
- 34. "Admiralty Manual of Scientific Enquiry," 1871.
- 35. " " " " " " 1886.
- 36. "Hints to Travellers," 2 vols. (*Royal Geographical Society.*)
- 37. "Text Book of Geology." (*Geikie.*)
- 38. "Deep Sea Deposits." (*Challenger's* volume.)
- 39. "Physical Observations during Voyage of National Antarctic Expedition," ship *Discovery*, 1901-04.
- 40. "Instructions for Investigating Magnetic Shoals." (*Hydrographic Department.*)
- 41. "Instructions for the Use of Douglas-Schafer Sounding Traveller." (*Hydrographic Department.*)
- 42. "Memoirs of Hydrography," Parts 1 and 2. (*Dawson.*)
- 43. "Stars and Sextants." (*Sprigge.*)
- 44. "Report on Under-currents of the River Congo." (*Purey-Cust.*)

From time to time publications of interest to Surveyors issued by the Hydrographic Department will be supplied for addition to the library.

A return of these books is to be rendered to the Hydrographic Department on Form H.—97 annually on the 31st December, and also when the ship pays off.

Particular care should be taken of the "Star Catalogues," the Challenger volume "Deep Sea Deposits," and "Principles of Forecasting" (*Abercrombie*), as the number of copies procurable is limited.

† Bound up in one volume, entitled *Tables for Use in Construction of Charts.*

22. Books lent from Admiralty Library.—Certain books of voyages and on other subjects are lent for the use of surveying ships from the Admiralty library; these bear the Admiralty library stamp, and are to be specially taken care of, and returned to the Hydrographic Department when no longer required on board. A return on Form H.—97 is to be rendered to the Hydrographer annually on the 31st December, and on paying off, showing the books that are on board. This return is to be separate from that showing the hydrographic books of reference on board.

23. Original Documents.—This name is given to various charts, maps, plans, triangulation schemes, &c., which have been received in the Hydrographic Department from the earliest times of hydrography, and in many cases, being the only copies in existence, are of very great value.

A return is to be made to the Hydrographer annually in December of all original documents belonging to the Hydrographic Department on board the ship, the number and title being stated, and the date when each document was lent.

All such documents are to be returned to the Hydrographic Department when no longer required, and must not be retained indefinitely. If it is necessary to keep any of them for a considerable time it is to be so stated in the annual return, and special application made for their retention.

The greatest care is to be taken of all recorded documents lent from the Hydrographic Department, and special attention paid to their preservation. They are on no account to be bent when being used, as by so doing the paper may become broken; no document is to be folded, but is either to be kept flat or rolled loosely. As few marks as possible are to be made on the documents, and then only in soft pencil, so that the danger of defacement by cleaning may be avoided.

Should any document become accidentally damaged, no attempt to repair it is to be made, but on returning it the circumstances that caused the damage are to be stated. The document will be properly repaired after return to the Hydrographic Department.

No additions or amendments are to be made to any of these documents without the Hydrographer's special sanction or direction, and any additions or alterations so sanctioned must be made clearly distinguishable from the original work by the use of coloured inks, and the nature, authority, and date of such amendments noted on the sheet near the title.

24. Transmission of fair sheets, original documents, and other matter connected with the survey.—Whenever fair sheets or other documents are transmitted to the Hydrographic Department, it is to be first ascertained whether there is any channel of conveyance free of cost to the Admiralty; if not, the package is to be sent by the safest route, freight being left to be

paid on delivery. Packages are to be addressed, The Hydrographer, Admiralty, London, and a list is to be forwarded separately showing in detail the contents of the box or package, the mode of conveyance, and route by which it is being sent, and the expected date of its arrival at the Hydrographic Department. A list of contents is also to be placed inside the box or package.

25. **Stationery.**—On pages 30-34 is given a list of articles usually supplied by H.M. Stationery Office for Naval Surveys. No hard and fast line can be drawn as to the requirements of individual surveys, and officers are not debarred from making requests for anything not on this list which may be required under special circumstances, but as a rule this list should be adhered to. Demands for stationery during a commission are to be sent in annually so as to reach the Hydrographic Department by 31st December.

In making demands, books, paper, and envelopes are to be kept distinct from small stores, and these again from surveying forms and books. When drawing-paper, which is liable to be damaged by damp climate, is demanded, it is to be stated how much of it, not required for immediate use, is to be hermetically sealed.

The supply of stationery to surveying ships is only made for use in connection with their special work, and great care is to be taken that it is only expended for this purpose, and that it is not wasted.

The supply of most articles issued at the beginning of a commission are usually sufficient to last the whole commission, and they should not, therefore, be demanded annually.

Care must be taken in making demands that unduly large quantities are not ordered. Many of the articles supplied are expensive and should be only demanded in very small quantities.

H.M. Stationery Office being a very large public department, charged with the duty of supplying books, stationery, and printing to all the public departments in the United Kingdom, surveying officers must not expect their demands to have priority of execution; and they must allow for fully two months between the date of a demand reaching the Hydrographic Department and its fulfilment by the Stationery Office.

26. **List of articles** which will be supplied through the Hydrographic Department on demand:—

BOOKS, ENVELOPES, AND PAPER.

Books, Entry (or Work), 300 pages, white foolscap.

"	"	"	"	"	ruled 33 lines.
"	"	"	"	"	" 53 "
"	Field, with Clasp, plain white or ruled—				
	9½ × 6 ins.				
	8½ × 5½ "				
	7½ × 4½ "				
	6 × 3½ "				

- Book Post Wrappers, 12×8 ins. }
 " " " 16×10 " } addressed Hydrographer.
- Bristol Boards, 33×25 ins., 8 sheet.
- Cloth, Tracing, "Alliance," Dull Back, Continuous, 30 ins. wide,
 No. 5.
- Cloth, Tracing, "Alliance," Dull Back, Continuous, 43 ins. wide.
- Envelopes, Thick, Cream Wove, No. 1, Printed O.H.M.S., and
 Gummed.
- Envelopes, Thick, Cream Wove, No. 2, Printed O.H.M.S., and
 Gummed.
- Envelopes, Thick, Cream Wove, No. 1, addressed Hydrographer.
- " " " " No. 2, " "
- Paper, Blotting, White, 18 lbs.
- " Buff, Foolscap, cut eight out of a sheet.
- " Foolscap, Cream Laid, 14 lbs., stamped Royal Arms.
- " " " " $\frac{1}{2}$ sheets, stamped Royal Arms.
- " " " " ruled 33 lines, stamped Royal Arms.
- " " " " 53 " " "
- " " Thin Typewriting, $\frac{1}{2}$ sheets.
- " Calculating (squared in faint lines) (special).
- " Semi-carbonic, Foolscap for Typewriting.
- " Cartridge, common, 45 lbs.
- * " Drawing, Antiquarian, H.P. (53×31 ins.), Whatman's No.
 1, mounted on linen.
- * " Drawing, Antiquarian, H.P. (53×31 ins.), Whatman's No.
 1, unmounted.
- * " Drawing, Double Elephant, H.P. ($40 \times 26\frac{1}{2}$ ins.), Whatman's
 No. 6, mounted on linen.
- * " Drawing, Double Elephant, H.P. ($40 \times 26\frac{1}{2}$ ins.), Whatman's
 No. 6, unmounted.
- * " Drawing, Atlas, H.P. (34×26 ins.), Whatman's No. 19, un-
 mounted.
- * " Drawing, Continuous, mounted on linen, 6 ft. broad, 6 yds.
 long, Harding's No. 23.
- " Drawing, Cartridge, Continuous, 60 ins. wide.
- " Lumberhand.
- " Post Quarto, Cream Laid, 22 lbs., stamped Royal Arms.
- " Tracing, Bretnall's No. 12, 30 ins. wide, Continuous, best
 quality.
- " Tracing, Bretnall's No. 12, 40 ins. wide, Continuous, best
 quality.
- " Tracing, Glacine.
- Sketch Blocks, 12×9 ins., Smooth.

* State whether all or any part is to be hermetically sealed in tin.

SMALL STORES.

Brushes, for Water colours:—

„ Sable—

Finest Red in Quills.

„ Camel Hair—

Small—Duck.

Medium—Extra Goose.

Large—Large Swan.

Wash brushes, No. 12 size.

Flat, $\frac{3}{4}$ in.

„ Sponge, Swan.

China Round Slant and Basin (special).

„ Tile Palettes, 6 divisions (special).

† Colour Boxes, filled with 16 following colours, whole cakes:—

Burnt Sienna.

Carmine.

Cobalt Blue.

Gamboge.

Hooker's Green, No. 2.

Indian Yellow.

Indigo.

Light Red.

Mars Orange (Special).

Payne's Grey.

Prussian Blue.

„ Green.

Raw Sienna.

Scarlet Lake.

Vermilion.

Yellow Ochre.

Date Tins, $4\frac{1}{2} \times 4\frac{1}{2}$, with cards.

Erasers, Steel, cocus handles.

„ Ink and Pencil, small.

„ Typewriter, circular.

Gum, liquid, in bottle, one gill, with brush.

India-rubber, grey, pliable.

„ Bands, Perry's Flat, No. 2 (Special).

„ „ „ „ No. 6 (Special).

Ink, Drawing, Mallandain's, waterproof—

Black.

Blue.

Brown.

Carmine.

Green.

† Refills to be demanded when required.

Ink, Orange.

„ Violet.

Ink Glasses, Crown, 3in. diameter.

„ Indian, sticks of.

„ Eradicator.

Inkstands, ebonised, No. 3.

Knives, Clasp (for field service).

„ Desk (cocus handle).

Lead Pressers, A, covered canvas (without handle).

Memorandum Books, 8vo., demy, cloth, 7 in. \times 4½ in., plain or ruled faint.

„ „ 8vo., demy, marble paper, plain or ruled faint.

Ox Gall, liquid.

Paper Fasteners, Large.

„ „ Small.

„ „ Gem clips.

Pencils, Black Lead, Drawing—

HB, H, 2 H's, 4 H's, 6 H's.

„ Red and Blue combined.

„ Chalks, Red and Blue.

Pencil-holders (for chalks), 1099.

Pens, Steel (to be asked for as gross or dozen, not boxes).

„ Gillott's Crow Quill, 659 (12 on a card, with holder).

„ Gillott's, 312 (12 on a card, with holder).

„ Perry's, 602, Tracing (12 on card, with holder).

„ Perry's Crow Quill, 603 (12 on card, with holder).

„ Gillott's, 290, Lithographic (12 on card, with holder).

„ Brandaur's, 516.

„ Gillott's, 303.

„ „ 353.

„ „ J.

„ Mitchell's Red Ink Pen, F.M.

„ „ Fleetwing, 0528 M.

Penholders—Universal, Improved.

Pins, packets of 2 oz.

„ Drawing, Large $\frac{1}{8}$ in. dia., Small $\frac{1}{16}$ in. dia.

Plumbago, in large cakes (Special).

Portfolios, 41 \times 28 \times 2½ ins. (Binding).

Sandpaper, blocks, 2½ \times 2¼ ins.

Small punch, No. 7.

Saucers, colour, nests 3½ ins. (Special).

Scissors, No. 1 (8 ins. long).

Sealing Wax, Red, India, 20 sticks to the lb.

Skins, Chamois Leather.

Sponges, size 2.

*Tape, pink—

Broad, $\frac{1}{2}$ in. wide, 12 pieces in packet, 9 yds. in piece.

Tin Cases, Japanned, Cylinder, with cover—

Diameter, 7 ins.	} To hold Roll of Mounted Drawing Paper,
Length, 6 ft. 6 ins.	
Length, 2 ft. 8 ins., diameter, 3 ins.	6 ft. x 6 yds.
„ 2 ft. 8 ins.	„ 4 ins.
„ 2 ft. 8 ins.	„ 5 ins.
„ 2 ft. 8 ins.	„ 7 ins.
„ 3 ft. 0 ins.	„ 6 ins.

Typewriter Ribbons for “ Empire ” Typewriter, Black Record.

27. **A typewriter** is supplied by the Hydrographic Department solely for use in all hydrographic correspondence, and the instructions given in Enclosure No. 52 to Guard Book of Special Admiralty Memoranda should be carefully followed as regards its repair, &c. If in need of repairs it should be returned to the Hydrographic Department when in Home Waters, and when abroad it will be repaired by a Dockyard. If a new typewriter is necessary to replace an old one which has been condemned as not worth repair it is to be demanded from the Hydrographic Department.

28. **Special books and forms** for recording and transmitting information are supplied by the Hydrographic Department, in accordance with the following list:—

29. LIST OF BOOKS SUPPLIED.

- H.— 12 Surveying Sketch Book.
- H.— 63 Chronometer Journal.
- H.— 64 Chronometer Comparison Book.
- H.— 85 Deck Book.
- H.—141 Height Book (Calculations).
- H.—142 Height Book (Mean of Heights).
- H.—143 Tide Journal.
- H.—144 Deep Sea Sounding Book (Fair).
- H.—145 Deep Sea Sounding Book (Rough).
- H.—146 Current Book.
- H.—148 Record of Tide Pole Readings.
- H.—149 Surveying Data Book.
- H.—157 Main Angle Book.
- H.—160 Tidal Diagram Book.

30. LIST OF FORMS SUPPLIED.

- H.— 15 Register of Tides.
- H.— 37 List of Deep Sea Soundings and Serial Temperatures.
- H.— 44 Label for pasting inside cover of all books containing Surveying Data.

*To be demanded as pieces, not packets.

- H.— 50 List of Instruments Lost, Returned to Hydrographic Department, or Surveyed by Ship's Officers.
- H.— 57 Form for Calculation of Latitude and Longitude.
- H.— 58 Form for Calculation of True Bearing.
- H.— 65 Tide Journal Sheets.
- H.— 68 Annual Return of Survey.
- H.— 77 Instrument Account.
- H.— 97 Return of Books on board for Professional Reference and Books lent from Admiralty Library.
- H.—112 On the Treatment and Packing of Chronometers.
- H.—125 Account of Receipt and Expenditure of Special Surveying Stores.
- H.—128 List of Hydrographic or Special Surveying Stores kept in stock at H.M. Dockyard, Chatham.
- H.—129 Requisition for Hydrographic or Special Surveying Stores.
- H.—130 Request for Survey by Dockyard Officers on Hydrographic or Special Surveying Stores.
- H.—147 Tidal Diagram Sheets.
- H.—152 Return of Meridian Distances.
- H.—153 Return of Latitude.
- H.—154 Return of Chronometers and Deck Watches.
- H.—155 Expenditure of Special Surveying Stores.
- H.—158 Diagram showing Uniform System of Marking Lead Line, large.
- H.—159 Diagram showing Uniform System of Marking Lead Line, small.
- H.— 7 False Station Corrector (Douglas).
See also page 36 for List of Returns, and when to be rendered.
- The following forms in general use in H.M. Navy are to be obtained from the accountant officer:—
- S.—378 Hydrographic Note.
- S.—379 Chronometer Return.
- S.—385 Magnetic Variation observed on Land.
- S.—386 Abstract of Variation observed at Sea.
-

LIST OF BOOKS, FORMS, AND RETURNS TO BE FORWARDED TO THE HYDROGRAPHIC DEPARTMENT, &c.

No. of FORM.	DESCRIPTION.	WHEN DUE.					REMARKS.
		Annually on Dec. 31st.	On completion of the Survey.	On finally paying off i.e. not recom. mentioning.	Occasional.	With fair chart.	
H—12	Surveying sketch book - - - -	—	Yes	Yes	—	—	
H—15	Register of tides - - - -	—	—	—	—	Yes	
H—37	List of deep-sea soundings and serial temperatures.	—	—	—	Yes	—	
H—50	List of instruments lost, returned to Hydrographic department, or surveyed by ship's officers.	—	—	—	Yes	—	On loss of article.
H—57	Form for calculation of latitude and longitude.	—	—	—	—	—	To be destroyed when no longer required.
H—58	Form for calculation of true bearing -	—	—	—	—	—	To be destroyed when no longer required.
H—63	Chronometer Journal - - - -	—	—	Yes	—	—	To be destroyed when finished with.
H—64	Chronometer comparison book - - -	—	—	—	—	—	To be destroyed when no longer required.
H—65	Tide journal sheets - - - -	—	—	—	—	—	To be rendered in duplicate with tracings of the areas surveyed and a brief account of proceedings for the year.
H—68	Return of survey - - - -	Yes	Yes	Yes	—	—	Is also to be rendered on supersession of commanding officer. If finally paying off to be accompanied by a report on all the more important instruments.
H—77	Instrument account - - - -	Yes	—	Yes	Yes	—	
H—85	Deck book - - - -	—	Yes	Yes	—	—	
H—97	Return of professional books of reference -	Yes	—	Yes	—	—	
H—97	Return of books lent from Admiralty library	Yes	—	Yes	—	—	See also Section II., page 29.
H—125	Account of receipt and expenditure of special surveying stores.	Yes	—	Yes	Yes	—	Is also to be rendered on supersession of the officer in charge of these stores. It is to be accompanied by receipts and vouchers and expenditure form H—155.
H—129	Requisition for hydrographic or special surveying stores.	—	—	—	Yes	—	

LIST OF BOOKS, FORMS, AND RETURNS TO BE FORWARDED TO THE HYDROGRAPHIC DEPARTMENT, &c.—continued.

No. of FORM.	DESCRIPTION.	WHEN DUE.					REMARKS.
		Annually on Dec. 31st.	On completion of the Survey.	On finally paying off, i.e., not recom- missioning.	Occasional.	With fair chart.	
H—141	Height book (calculations) - - -	—	Yes	Yes	—	—	To be destroyed when no longer required.
H—142	Height book (means of heights) - - -	—	Yes	Yes	—	—	
H—143	Tide journal - - - - -	—	Yes	Yes	—	—	
H—144	Deep-sea sounding book (fair) - - -	—	—	Yes	—	—	To be destroyed when finished with.
H—145	Deep-sea sounding book (rough) - - -	—	—	—	—	—	
H—146	Current book - - - - -	—	Yes	Yes	—	—	
H—147	Tidal diagram sheets - - - - -	—	—	—	—	—	To be destroyed when finished with.
H—148	Record of tide pole readings - - - -	—	—	—	—	—	
H—149	Surveying data book - - - - -	—	Yes	Yes	—	—	
H—152	Return of meridian distances - - - -	—	—	—	Yes	—	Rendered when obtained { These forms are to be num- Rendered when obtained { bered consecutively for the commission.
H—153	Return of latitude - - - - -	—	—	—	Yes	—	
H—154	Return of chronometers and deck watches -	Yes	—	Yes	—	—	
H—155	Expenditure of special surveying stores -	Yes	—	Yes	Yes	—	See also form H—125.
H—157	Main angle book - - - - -	—	Yes	Yes	—	—	
—	Field, sight, and sounding books - - -	—	Yes	Yes	—	—	
—	Demands for instruments required during ensuing season.	Yes	—	—	—	—	To be destroyed when finished with on the completion of the survey.
H—160	Tidal diagram book - - - - -	—	—	—	—	—	
MSS.	Report on worn or damaged instruments -	—	—	—	Yes	—	
MSS.	Orthography book - - - - -	—	—	—	—	—	Accompanies worn or damaged article forwarded to the Hydrographic Department for repair. Not required. Is only for convenience of officer in charge of survey.
MSS.	Special cases of loss of special surveying stores.	—	—	—	Yes	—	

LIST OF BOOKS, FORMS, AND RETURNS TO BE FORWARDED TO THE HYDROGRAPHIC DEPARTMENT, &c.—*continued.*

38

No. of FORM.	DESCRIPTION.	WHEN DUE.						REMARKS.
		Annually on Dec. 31st.	On completion of the Survey.	On finally paying off i.e., not recom- missioning.	Occasional.	With fair chart.		
MSS. MSS. or S378 or Telegram	Return of original documents- Important dangers- - - -	Yes —	— —	— —	— Yes	— —	See Section III., page 47. If a telegram is sent the infor- mation is to be confirmed by a MS. report or on S 378.	
MSS. MSS. or S378	Sailing directions - - - - Special report on non-discovery of dangers, &c., already charted, or greater depths over same.	— —	Yes —	— —	— Yes	Yes Yes	To be rendered with fair chart or as occasion demands.	
S 378	Hydrographic note- - - -	—	—	—	Yes	—	Rendered as required.	
S 385	Magnetic variation observed on land	—	—	—	Yes	—	When obtained.	
S 386	Abstract of variations observed at sea	—	—	—	Yes	—	When obtained.	
—	Meteorological logs- - - -	—	—	—	Yes	—	See Section II., page 27.	

BOOKS AND STATIONERY.

[Section II.]

SECTION III.

THE SURVEY.

Much must depend upon the nature of the survey, *i.e.*, whether it is to be a sketch, ordinary, or detailed survey (*see* "Hydrographical Surveying," Wharton and Field, page 60), as to how far the chart should be complete in all details; the charting of the globe has, however, now so far advanced that, as a rule, a survey must be carried out as thoroughly as circumstances will allow.

No competent Surveyor will ever permit the triangulation, which is the foundation of everything, to be in error, and, even when the points are irregularly plotted by means of ships' stations, boats, or beacons, they should still be as accurate as the ordinary needs of navigation demand.

1. **Soundings.**—The soundings are undoubtedly the most important part of a chart. A grave responsibility rests upon Surveyors in the present day: vessels of great size, weight, and value have to trust entirely to the charts to avoid dangers. The irreparable loss and damage that may occur to one of these vessels by stranding, even in the smoothest water, on some danger not detected in the course of the survey, must always be borne in mind. It is only by close sounding and a further rigorous examination of the smallest indications of all irregularities of the bottom, that any reasonable assurance can be felt of the completeness of the survey.

An original chart cannot contain too many soundings. None which can be legibly shown are ever to be eliminated with the object of improving the appearance of the chart: this is the work of those who prepare the chart for the engraver at the Hydrographic Department. It is obvious, however, that there is a limit to the number of soundings that can be legibly shown on paper, depending on the scale of the chart.

In a detailed survey the usual practice is to run lines of soundings, perpendicular to the coast, out to depths of 15 or 20 fathoms at a distance apart of about two-tenths of an inch, whatever the scale may be; consequently the smaller the scale the less the thoroughness of the examination and also the greater the responsibility and difficulty of the surveyor in ensuring that no dangers are omitted.

Where irregularities of depth are found to exist, or where, from the rocky nature or formation of the coast, they may be expected to occur, both intermediate and cross lines of soundings must invariably be run, although only a proportion of the soundings can appear on the chart, and the smallest indication of dangers must be thoroughly examined by methods such as are described on page 202, "Hydrographical Surveying" (*Wharton & Field*). On a small scale a narrow tongue of shoal ground, lying between two lines of soundings, may easily exist, either isolated or running off from a reef or point of land, even though the lines are as closely spaced as the scale will permit; but a few cross lines will considerably diminish the risk of missing such a shoal.

In addition to which, in such localities as the above which are frequented, or likely to be frequented, by shipping, the further precaution of "sweeping" by ship or boats must be taken in order to ensure that no dangers exist. Although the scale is the principal factor in revealing shoals, the fact remains that, generally speaking, it is seldom practicable to carry out coast surveys on a larger scale than about 2 inches to the mile; the Surveyor must, however, make the most of the scale upon which he is working by interlining and cross-lining, as he considers necessary.

Particular attention must be paid to the soundings within the 10-fathom line, where the most rigorous examination is especially necessary.

A point to be borne in mind is that in many cases, on a coast survey where anchorage exists, although the judgment of the Surveyor may be perfectly sound, that a large scale plan is unnecessary, yet it may nevertheless be desirable to differentiate it from the surrounding work by running additional lines of soundings. In fact, any indentation in a coast which may lead a vessel to close the land for anchorage in time of necessity, or any promontory which might have a similar effect upon her course for passing or rounding it, must receive special attention, notwithstanding that it may not be necessary to make a large scale plan of it.

On any change of direction in lines of soundings special care must be taken to avoid leaving large unexamined areas.

2. Sweeping.—The increase in draught of modern vessels renders it more than ever necessary that all navigable channels should be most thoroughly examined in order to detect any pinnacle rock, when the nature of the bottom or of the neighbouring shore is known to be rocky. Not only should the soundings be close and every indication of irregularities in the depths be further closely examined, to ensure that no dangers exist in the vicinity, but it is also necessary to devise means for discovering pinnacle rocks, of which, in spite of the closeness of the soundings, no indications have been found.

It is to be borne in mind that a depth of 35 feet is now a danger to large vessels in smooth water, whilst even 40 feet may be a danger with any scend of sea.

Various methods of sweeping have been tried which are fully explained in the Hydrographic Annual, Nos. 1 and 2, 1912-1913, and with the necessary modifications to suit different types of ship, conditions of wind and tide, &c., will suggest a system on which to proceed.

Every advantage must be taken of the local knowledge of fishermen and others to ascertain the existence of pinnacle rocks.

In a detailed survey, when on a large scale, and the rise of tide is great, it is essential that the low-water line should be obtained not only by the reduced soundings, but by passing round it at low water spring tide, and drawing it in by actual observation and fixes.

It is impossible to lay down hard and fast rules as to sounding, but the Surveyor must be guided by his own judgment and knowledge of the locality, and he must constantly bear in mind that every possible precaution is to be taken against the omission of existing dangers.

In counselling the necessity, however, for close lines of soundings, and utilising the capacity of a given scale to its utmost by crossing the lines of soundings, and sweeping in certain cases, it is fully recognised that this means greater time spent over the examination of a given area, and in consequence an apparently smaller output of work.

The existing chart of a locality of which a re-survey is in progress is always to be closely examined to ascertain if all dangers shown on it have been found in the new survey. In all cases where shoal soundings, either shown on the chart or since reported, are not revealed by the survey, a special report is to be forwarded to the Hydrographer, stating what grounds there are for supposing that these shoal soundings do not exist, together with a tracing of a portion of the new survey covering the vicinity, and expressing an opinion as to whether they should be retained on the chart.

3. Accuracy of soundings.—The increased attention in late years paid to improving sounding apparatus and methods of sounding has resulted in increasing the rapidity and ease with which the soundings can be taken. There is danger, however, that the gain in this respect may be altogether discounted unless corresponding increased care be taken to ensure (1) the absolute reliability of each individual sounding called by the leadsman, (2) that the soundings so called are correctly entered in the book, (3) that if any sounding, when so entered, appears at all suspicious, reference be at once made to the leadsman to confirm the entry or otherwise, in order that no doubt may arise hereafter.

The best leadsman is bound sooner or later to call a false sounding, which, if undetected at the time, may result in considerable loss of

time in endeavouring to account for it afterwards. Actual supervision of the leadsman by the Surveyor is absolutely essential on all occasions, whether in ship or boats, not only to check the correct reading of the marks on the line, but to ensure as well that no soundings are accepted unless the line is properly up and down; such supervision is all the more necessary in ships where the bridge is at one end of the ship and the soundings are obtained at the other end.

When the ship is turning under a large angle of helm, as at the end of a line of soundings, not only are the soundings liable to be inaccurate from the lead line not being up and down, but the position of them is often doubtful as well.

Fixes should not be too far apart even when the depths are regular, and the more irregular the depths, or the quicker they vary, the closer should be the fixes. When this is not attended to, contour lines when drawn often exhibit a wavy line wholly inconsistent with nature.

Cross lines must occasionally be run in order to check the accuracy of the soundings already obtained; this is especially necessary when the range of tide is considerable, in order to test the corrections of the tidal reductions used.

Errors in the tidal reductions may be due to the observations themselves being incorrectly recorded, or to local causes when the tide pole is at a considerable distance from the area sounded, but error is more likely to occur in those cases where no actual observations of the tide are possible and the reduction can only be obtained from the calculated tidal curve for the day. Errors may also be expected both in time and height of high and low water, and although these may not be in themselves very great, an error of even half an hour at high water may cause an error in the reduction at half tide of several feet if the range is considerable.

The results of incorrect tidal reductions are not only that the soundings are as a whole in error, but that they are relatively incorrect in comparison with each other, and may thus give an entirely erroneous idea of the contours of the bottom.

Whenever it is practicable, a tide pole should *always* be put up in the immediate vicinity of any area where sounding is to take place, even if it is only for the actual time during which soundings are being obtained, in order to ensure, at anyrate, their *relative* correctness. Provided a reading of the pole is connected with some fixed object on shore, or with some rock that cover and uncovers, errors of datum can afterwards be corrected.

It is to be the *invariable* rule when sounding to note the exact times when certain rocks cover and uncover, and to compare them with the readings at these times of the tide gauge. Not only does this afford a valuable check to the accuracy of the tidal reductions,

but such information is often of the very greatest value in after years when questions arise as to the datums used. Some of the most easily recognised of these rocks, and their comparisons with the tide gauge readings, are to be entered in the Surveying Data Book (H.—149) and Tide Journal (H.—143).

4. Reduction of soundings.—

- (a) To convert tidal reductions in feet and inches into fathoms and fractions of fathoms, the following equivalents are to be used, viz:—

Under 6 inches to be considered equivalent to 0 fathoms.

6 inches to 2 feet to be considered equivalent to $\frac{1}{4}$ fathom.

2 feet to 3 feet 6 inches to be considered equivalent to $\frac{1}{2}$ fathom.

3 feet 6 inches to 5 feet to be considered equivalent to $\frac{3}{4}$ fathom.

5 feet to 6 feet 6 inches to be considered equivalent to 1 fathom, and so on.

- (b) To convert soundings in feet (after being reduced) into fathoms.

1 or 2 feet to be considered as $\frac{1}{4}$ fathom.

3 " " " $\frac{1}{2}$ "

4 " 5 " " " $\frac{3}{4}$ "

6 " " " 1 "

7 " 8 " " " $1\frac{1}{4}$ fathoms.

9 " " " " $1\frac{1}{2}$ "

10 " 11 " " " $1\frac{3}{4}$ "

12 " " " " 2 "

and so on up to 7 fathoms.

42, 43, 44 feet to be considered as 7 fathoms.

45, 46, 47 " " " $7\frac{1}{2}$ "

48, 49, 50 " " " 8 "

and so on up to 11 fathoms.

67, 68, 69 feet to be considered as 11 fathoms.

70, 71, 72 " " " 12 "

and so on.

- (c) In reducing soundings obtained in feet, if the reduced sounding is under one foot:—

1 inch is to be considered as "drying."

1 to 3 inches is to be considered as "awash."

4 to 6 inches is to be considered as $\frac{1}{2}$ foot.

7 to 12 inches is to be considered as 1 foot.

Except in such shallow depths, however, the nearest foot of reduction only should be applied, thus:—

A reduction of 1 foot 5 inches should be applied as 1 foot.

" " 1 " 7 " " " 2 feet, &c.

Uniform system of marking lead lines.—See Section I., page 21.

Uniform system of calling soundings.—

For that portion of the line which is marked	Soundings are to be called	
In fathoms and feet.	To the nearest foot.	"Five three," "five two," "five one," "five fathoms," "four five," &c.
In fathoms and half fathoms.	To the nearest estimated quarter of a fathom.	"Fifteen fathoms," "fourteen and three-quarters," "fourteen and a half," "fourteen and a quarter," "fourteen fathoms," &c.
In fathoms only (20 to 30 fms.).	To the nearest estimated half fathom.	"Thirty fathoms," "thirty and a half," "thirty-one fathoms," &c.
At every 5 fathoms (above 50 fms.).	To the nearest estimated fathom.	"Ninety fathoms," "ninety-one fathoms," &c.

Note.—The only exception to the above is that 9 and 11 fathoms are to be called "deep nine" and "deep eleven," the word fathom being omitted, in order to distinguish them from 5 and 7 fathoms, thus:—

"Deep nine one," "deep eleven," "deep eleven and a quarter," &c.

Should, for some special purpose, soundings be required to a greater accuracy than the nearest foot, the nearest 3 inches can be called, thus:—

3 inches less than 5 fathoms - - - "Four five nine."

Nature of the bottom in coast or harbour surveys.

—The nature of the bottom is to be carefully noted in the sounding book; in many cases the specimen brought up by the lead is merely that of a thin surface layer, and in anchorages the material brought up on the flukes of anchors, whether of ship or boat, must be examined to get a better idea of the holding ground.

4. **Deep sea soundings.**—A more perfect knowledge of the configuration of the ocean bed is highly desirable, and it is therefore to be considered as a general rule that, when on passage, a surveying ship should take every opportunity of obtaining positive deep casts.

As the 100-fathom line is generally the limit of a survey, the slope beyond that depth to deep water is very frequently unknown. A surveying vessel approaching a coast sounded in this manner is, if possible, to take the necessary soundings, and so obtain the slope.

Whilst on passage, if the depths allow, every opportunity is to be taken to improve the charts, by obtaining positive soundings with the ship's ordinary sounding gear, reducing the speed as necessary, when this can be done without undue delay. Depths by tube or by the amount of wire run out are of no value for the correction of charts.

The results of deep sea soundings are to be forwarded at once, on Form H.—37, which is supplied for the purpose, in order that they may be included in the Annual List of Oceanic Soundings and Deep Sea Temperatures published by the Hydrographic Department.

5. **Nature of ocean bottom.**—All oceanic deposits contain small black, red, and yellow magnetic particles, but these are most abundant in the clays. Should the sounding tube come up empty, as it does occasionally, though rarely, it must be carefully examined on the outside for black-brown streaks, as these indicate the presence of oxide of manganese at the bottom in the form of nodules or stones too large for the tube to bring up.

As it is important to describe the substances brought up in the sounding tube by terms readily recognisable, and as the following were adopted after much consideration by the scientific staff of the *Challenger*, surveyors employed in deep sea sounding must endeavour so far as is practicable to follow this nomenclature.

The deposits on the floor of the ocean may be classed under the following heads:—

- a. *Shore deposits.*—Within a distance of about 200 miles from land the deposits partake of the nature of the coast, thus: Around volcanic islands the deposits are grey or black in colour and consist chiefly of pumice, scoriæ, and volcanic sand; around coral islands the deposits are white and consist of the detritus of the neighbouring reefs: whilst in the vicinity of land which is not volcanic or coral, the deposits are usually blue or green muds, and consist chiefly of the detritus of rivers and washings from the coast. These latter contain frequently some surface shells and diatoms. The green muds are especially interesting, as they generally contain some beautiful internal casts of carbonate of lime organisms in glauconite.
- b. *Globigerina ooze* is widely distributed over the bed of the ocean. It is of a white or light brown colour and sticky nature, and consists chiefly of minute globular shells of carbonate of lime called globigerina. It is easily known by its appearance under the microscope and from the fact of its effervescing strongly when treated with dilute hydrochloric acid. It has occasionally been found at a depth of 2,800 fathoms, but is usually purest at 2,000 fathoms.
- c. *Pteropod ooze* is somewhat similar to globigerina ooze, but consists largely of the shells of animals (Pteropods), which can be seen without artificial aid. It also effervesces when treated with dilute acid, but generally will be found at depths under 1,200 fathoms when little or no land debris exists.
- d. *Diatom ooze* is of a white, greenish, or rose colour, and is chiefly composed of the silicious casts of minute plants (Diatoms). It

effervesces but slightly, if at all, when treated with acid, and has hitherto been found only in the Antarctic ocean.

- e. *Radiolarian ooze* may be white or brown in colour, and is composed principally of the skeletons of minute animals (*Radiolaria*) intermixed occasionally with a few globigerina shells. When so intermixed it effervesces slightly with dilute hydrochloric acid, but when pure it does not effervesce. The skeletons of these *Radiolaria* are beautiful objects under the microscope. This deposit has hitherto been found only in the Pacific and Indian oceans at depths exceeding 2,300 fathoms.
- f. *Red, grey, or chocolate clays* are widely distributed over the floor of the ocean at depths exceeding 2,100 fathoms. The red colour is due to the presence of oxide of iron, and the chocolate colour to peroxide of manganese. Pumice stone, manganese nodules, shark's teeth, and the ear bones of whales have frequently been found embedded in the clays, which do not effervesce when treated with acid unless, which is occasionally the case, they have a slight intermixture of globigerina ooze.

The specimens recovered from the bottom are to be carefully placed in bottles, marked, with the name of the ship, the number of the sounding corresponding to that in the sounding book, position, and depth.

The bottles must be filled with sea water, with a small quantity of colourless spirit added, and forwarded to the Hydrographic Department.

6. **Vigias.**—It is the special duty of surveying ships to examine all reported dangers in the vicinity of the survey, or that may lie near their course whilst on passage. The number of these vigias on the charts has been considerably diminished in recent years, but others are frequently reported, and every effort must be made to verify or disprove them. A day will therefore be well employed devoted to the search for any that will not draw a vessel too far from her course or from her surveying ground.

Positive casts must be obtained, "no bottom" soundings being valueless. The submarine sentry towed at a suitable depth may save hours of searching. With a like object in view, the surveyor will keep his eyes open to any unusual appearance in the sea, such as partial rippings and, when out of reach of land, discoloured water; also flocks of birds, or shoals of fish, as they may possibly be indications of some change in the depth.

Every fresh report on the station on which the ship is serving must be enquired into, if possible from the originator of the report, and if it appears credible an opportunity should be taken to examine the locality. See "Hydrographical Surveying" (*Wharton & Field*), pages 214 to 218.

7. **Coral formations.**—The theory which has for some time been countenanced that coral atolls and fringing reefs, with deep water around them, invariably indicate a long-continued movement of subsidence of the nucleus on which they are built, has had considerable doubt thrown upon it by recent investigations.

To permit of a thorough discussion of the question, observations are much required on the precise slope of their outer edges, and of the materials of which that slope is composed.

All opportunities should therefore be seized of obtaining careful sections of such reefs as stand in deep water, both on the windward and leeward side.

The soundings should be obtained at every few feet, horizontally, from the edge of the reef, and the nature of the bottom carefully ascertained. The soundings must be carried to deep water, say, 1,000 fathoms, though, as the distance from the reef increases, they need not be so close together.

A special report will, of course, be made of such observations, accompanied by sections drawn on an equal scale, vertical and horizontal, of 30 fathoms to one inch, the slope being to the left, with a plan of the reef where possible.

8. **Prompt notice of new dangers.**—Whenever any new danger or feature of immediate importance is found, it is at once to be communicated to the Commander-in-Chief of the station, the Senior Naval Officer in port, or in the immediate vicinity, the local port or harbour authority where such exists, and the principal marine authority of any British State or colony affected, as well as to the Hydrographer for publication, in advance of the full sailing directions or fair charts.

9. **Deep sea temperature.**—When deep soundings are being obtained the deep-sea thermometers supplied should be occasionally attached to the wire in order to obtain the temperature at the bottom and at various depths.

Accurate knowledge of the depth of warm surface currents is particularly required, and to this end thermometers, at short distances apart, to a depth of about 200 fathoms, should be attached to the wire of a small sounding machine.

The serial temperatures obtained by various scientific expeditions have thrown much light upon the circulation of the under strata of the sea, and it is very desirable that these observations should be continued. Opportunities should therefore be utilised in order to gain more knowledge on this point. It is important that all temperatures should be corrected for the errors of the thermometers, and a notation made that they are so corrected; these errors are furnished with the instruments.

The number of the thermometer used is always to be entered in the Deep Sea Sounding Book, and the list of deep-sea thermometers on

board, with their individual corrections, must be inserted in the place provided at the beginning of the book.

10. Temperatures of the surface.—It has been observed on various coasts that the temperature of the sea near the shore is considerably lower than that in the offing. Much interest in connection with the subject of oceanic circulation attaches to this fact, and when running soundings perpendicularly to a coast a series of surface temperatures should be occasionally obtained.

11. Datums and bench marks.—Soundings are in all cases to be reduced to the approximate level of mean low water of spring tides. When information is obtainable as to the level to which equinoctial springs, or extraordinary tides, due to meteorological causes, may fall, the amount which this is below the datum employed is to be given in the title of the chart. It may frequently be necessary, from want of time and information, to employ an approximate datum, but efforts must always be made to refer the datum to a fixed mark of a permanent character on shore.

In Great Britain and other countries where there are regular bench marks, the datum is always to be connected by levelling to them; references to two or three bench marks are to be made if possible. *See also Instructions for Keeping Tide Journal (II.—143).*

12. Tides.—Attention is called to the pamphlet "Introduction to the Tide Tables," issued by the Hydrographic Department, stating the method adopted at the Admiralty in discussing tidal observations. Observations on the tides are very important. Besides the necessity of a daily knowledge of the condition of the water level for the purpose of accurate reduction of the soundings, continued observations for the purpose of affording material for local prediction and for the study of the movement of the tidal wave in general are much required. Though, from the circumstances of many marine surveys, these observations cannot frequently be of long duration, they must be as complete as circumstances will permit, and surveyors are to make every endeavour to make them so.

The varying range of the tides in different places is a subject of much interest, though when the rise and fall is very small, it is not of such importance. However, an investigation of the range cannot be carried out in any case without a complete series of observations.

In most cases, and especially when the range is small, it is necessary, in order to obtain the true instants of highest and lowest water, to register the observations at successive intervals of five or ten minutes both before and after the culminating points, and then to adopt the mean of the middle times shown by each corresponding pair of heights.

To enable observations to be of service to science, and also more certainly to obtain the true establishment and the diurnal inequality of the tides, it is necessary that the observations on the tides should be

as carefully registered at night, as are those made by day for the purpose of reducing the soundings obtained in the progress of the survey.

The best record of tides when a self-registering gauge is not available, is an hourly observation of the water level, supplemented by the exact time of high and low water, obtained as mentioned above.

The time used must be standard or local mean time, and a note stating which time has been used is to be placed on all tidal documents sent into office; the correction from local to standard time, and vice versa, is also to be given. The observations should be extended over thirteen lunations where practicable.

It is but seldom that surveying vessels are able to carry on observations as steadily as this, but opportunities for observing for a full lunation must never be missed.

13. Establishments printed in the Admiralty Tide Tables are not to be altered without reference to the Hydrographic Department. They are mostly founded on long and continuous observations, and should not therefore be altered except from a longer series of observations than those on which they depend. Should they be found to be in error to any considerable extent, attention should be called to the fact when the tidal observations and other documents relating to the survey are forwarded.

It must be borne in mind that an establishment cannot be calculated with any degree of accuracy by any simple method on less than six months' observations, and for the calculation of a true establishment nineteen years' continuous observations are necessary.

At ports predicted in the Admiralty Tide Tables, or for which tidal constants are given, continuous observations are not required. Tides at such ports should therefore only be observed for the purpose of reducing soundings, &c., and they are to be inserted in the Tide Journal only.

At all other ports and anchorages every endeavour must be made to obtain as long and complete a series of continuous observations as possible. A long series of observations at one place is of greater value for analysis than observations for short periods obtained at several different positions, and therefore when an extended survey is in progress continuous observations should be obtained at one place, subsidiary tidal stations being made as necessary for obtaining observations for the reduction of soundings only.

Reducing tidal observations.—Observations are to be reduced as shown in the Introduction to the Admiralty Tide Tables.

In connection with tidal observations, the interesting question of the movement of the land with reference to the mean level of the sea demands attention, and furnishes a further reason for the necessity of referring tidal observations to a permanent bench mark mentioned on page 48.

The following is an extract from the "Instructions to H.M.S. *Challenger*," 1872:—

"The mean sea level can be obtained from any long series of observations of the tides, but a good determination of it by the simple operation of taking means may be made, in less than two days, with even a moderate number of observations *properly distributed so as to subdivide both solar and lunar days into not less than three equal parts.*

"Suppose, for example, we chose 8-hour intervals, both solar and lunar.

"Take a lunar day at 24h. 48m. solar time, which is near enough, and is convenient for division; and choosing any convenient hour for commencement, let the height of the water be observed at the following times, reckoned from the commencement:—

h.	m.	h.	m.	h.	m.
0	0	8	0	16	0
8	16	16	16	24	16
16	32	24	32	32	32

"The observations may be regarded as forming three groups of three each, the member of each group being separated by 8 hours solar or lunar, while one group is separated from the next by 8 hours lunar or solar. In the mean of the 9 results the lunar and solar semidiurnal and diurnal inequalities are all four eliminated.

"Nine is the smallest number of observations which can form a complete series. If the solar day be divided into m and the lunar into n equal parts, where m and n must both be greater than 2, there will be mn observations in the series; and if either m or n be a multiple of 3, or of a larger number, the whole series may be divided into two or more series having no observation in common, and each complete in itself. The accuracy of the method can thus be tested, by comparing the means obtained from the separate sub-series of which the whole is made up.

"Should the ship's stay not permit of the employment of the above method, a very fair determination may be made in less than a day, by taking the mean of n observations taken at intervals of the n th part of a lunar day, n being greater than 2. Thus if $n=3$ these observations require a total interval of time amounting to only 16h. 32m. The theoretical error of this method is very small, and the result thus obtained is very far preferable to the mere mean of the heights at high and low water.

"The mean level thus determined is subject to meteorological influences, and it would be desirable, should there be an opportunity, to re-determine it at the same place at a different time of year. Tidal observations should, when practicable, include at least one determination of mean sea level by either of these methods. If the tide pole is erected for any length of time, a second and third determination are desirable as a check."

It should be distinctly understood that the mean sea level, as found by either of the methods described above, is correct only for the time of the observation. Mean sea level is subject to monthly and yearly variations, the cause of which have not yet been fully analysed. When continuous tidal observations extending over one lunation or more have been obtained, the best value of mean sea level will be found by meaning *all* hourly heights. The mean of the heights of high and low water will only give mean tide level, which, especially at the mouths of rivers and at places where shallow water extends some distance off-shore, may differ considerably from the mean sea level.

14. Records of tidal observations.—The Tide Journal, H.—143, is to contain a complete record of all tidal observations; care is to be taken that the date and place are filled in at the head of every page, and that full information as to comparison between the pole and a fixed mark on shore is inserted for every position of the pole, and also the reading on the pole to which the soundings were reduced.

The Tide Journal is to be forwarded to the Hydrographic Department at the conclusion of the survey.

Tide Journal Sheets, Form H.—65, are supplied for convenience of the transmission of tidal information from the tidal observation party to the ship during the actual progress of the survey. These forms are not to be forwarded to the Hydrographic Department, but are to be destroyed when no longer required.

The Register of Tides, H.—15, gives the time and height of the high and low waters observed, and is to be filled in from the Tide Journal whenever continuous observations extending over one lunation or more have been obtained. All information with regard to datum, mean sea level, &c., is to be given in the register in the place provided.

The Register of Tides is to be forwarded to the Hydrographic Department with the fair chart of the locality.

Forms for Tidal Reductions, H.—147, are supplied for the purpose of facilitating the calculation of the reduction to be applied to the soundings obtained; they are for use in the course of the survey only, and are not to be forwarded to the Hydrographic Department.

Record of Tide Pole Readings, H.—148, is to be kept in accordance with instructions therein. This book is not to be returned to the Hydrographic Department, but is to be destroyed when finished with.

15. Tidal streams.—The direction and rate of the tidal streams is of important and immediate interest to the seaman, and observations of these should by no means be neglected, especially the time of turning with reference to high water.

Off many coasts these streams run to a different point of the compass at every hour of the tide. The phenomenon known as tide and half tide, when the tidal stream changes at a totally different hour to

that of the vertical rise or fall on the adjacent shore, takes place on many coasts, especially in channels, and the knowledge of its existence is most essential to navigation.

To ascertain these points the ship or a boat should be anchored in suitable positions off-shore to observe the streams and their velocities, especially when these are considerable; and generally, whenever the ship is at anchor in a tideway, the rate and direction of the current should be obtained every hour by means of the current log.

A weighted bucket slung under a Kisbie lifebuoy drifting with the tide and fixed at intervals by angles is also an effective method when the tidal streams run with considerable velocity.

In home surveys the tidal streams in inner channels and ports are to be referred to the nearest standard port of reference, excepting in a few cases, where there is no standard port sufficiently near, such as Kyle Rhea, where they should be referred to high water by the shore.

Tidal streams in main passages and off the open coast are always to be referred to Dover; all references being given as before or after high water, low water never being referred to for the reason that in many places low water does not take place midway between the two high waters, and mistakes may therefore arise.

The terms "flood" and "ebb" stream are never to be used, excepting in a port, and only then when the turn of the stream is within an hour of high water or low water; the true direction in which the stream is flowing is to be given in degrees from 0° to 360° .

In surveys abroad the streams in the neighbourhood of standard ports of reference, given in the tide tables, are to be referred to those ports, elsewhere to the local mean time of high water.

16. Surface currents.—The direction and rate of permanent surface currents in the oceans is also a subject of much interest and practical utility, and demands constant attention.

The method of assuming the difference between the true and dead reckonings to be due to a steady current lasting through the 24 hours is unsound, being based only on approximate data.

More accurate observations must be made when weather permits by lowering a boat, her position being maintained by dropping a lead to a considerable depth, say, 200 fathoms, with an attachment that will present an area of resistance to the drag of the boat, and then heaving a current log. Such observations must be recorded in the Current Book, H.—146, and also specially reported to the Hydrographer.

17. Undercurrents.—In the few cases in which experiments have been carried out in straits where strong surface currents, due mainly to wind, exist, undercurrents have been found running in the opposite direction. Observations in such localities will throw much light on oceanic circulation, and a little time spent in making them will not be thrown away. Reference to the pamphlets on "Currents

in the Dardanelles and Bosphorus" and "Undercurrents in the River Congo," 1899, will furnish information on the methods successfully employed, but it is probable that these may be much improved upon. See "Hydrographical Surveying" (*Wharton & Field*), pages 410 to 416.

18. **Wave measurement.**—Among the other useful observations which might engage the ingenuity of a surveying officer, on his several passages, may be mentioned the magnitude of the waves in those parts of the ocean where the sea has an unlimited fetch, since there is reason to believe that the altitude to which they are lifted, as well as the distance between two following ridges, have been much under-estimated. A good attempt may be made to measure their vertical height by mounting the rigging until a line from the observer's eye to the horizon becomes a tangent to the summit of the intervening wave—the vessel at the moment must be upright, and in the lowest part of the trough between two waves.

Consort vessels, when nearly in each other's wake, and knowing their actual distance apart, by the elevation of each other's masts, can accurately determine the breadth of the valley that separates two of these huge undulating masses. The same result may be obtained by towing an object astern at a measured distance.

19. **Chronometric meridian distances** must be, if possible, founded on travelling rates and observations of equal altitudes made by the same observers, with the same sextants, and at nearly the same altitudes. See "Hydrographical Surveying" (*Wharton & Field*), pages 333 *et seq.*

Two observers at least should be employed for the purpose of checking one another independently, but as proficiency in this important part of a Naval Surveyor's duty can only be attained by practice, it is well to include as many of the assistants in the observation as possible. The result is always to be forwarded on the form supplied, H.—152, and these forms are to be numbered consecutively for the whole commission, care being taken to state the nature of the observations, *e.g.*, equal altitudes of sun or stars, absolute altitudes of sun or stars, &c. For specimen form, see "Hydrographical Surveying" (*Wharton & Field*), page 350.

It is to be remarked that only one form is to be forwarded for each meridian distance. The intercomparisons being common to all observers, the meridian distance by the different chronometers will vary in a similar proportion for each observer, and therefore it is only necessary to record the individual results for each chronometer as determined by one observer, the final mean result of other observers being recorded in the allotted place at the foot of the form. The form thus filled up records the regularity of the different chronometers, and also the range of the results by different observers, and affords a means of judging the value of the final result.

Before entry on the form, the individual result of each chronometer by each observer must be compared to ascertain clerical errors, as they should all differ by the same amount as shown by the results by the standard chronometer, if the same intercomparisons between the standard and the other chronometers have been used.

The value of the observations are always to be given on the form as V.G., G., F., or I. (for very good, good, fair, or indifferent).

20. Telegraphic meridian distances.—The electric telegraph must be utilised for the purpose of obtaining differences of longitude whenever possible.

As a meridian distance thus measured is capable of great precision, it must be the earnest endeavour of all Surveyors to make the result as final as the sextant will permit. To this end it is desirable that the observations should be rendered in more detail than in the case of chronometric meridian distances. See "*Hydrographical Surveying*" (*Wharton & Field*), pages 329, 330.

Every set of observations to obtain the individual errors of the chronometer or chronometers employed must be given, to show the accuracy obtained. Two chronometers may conveniently be used in the signals, as a check, but it may be observed that it is of no advantage to ascertain the errors of any chronometers not actually used in sending signals.

The signals should be exchanged on at least three entirely independent occasions, the errors of the chronometers used being found by entirely different sets of observations.

The unsatisfactory part of a telegraphic meridian distance is the personal error of the observers, both in the determination of the error of the chronometers, and in giving and receiving the signals, and if these are not eliminated in some way, it may happen that the value of the difference of longitude so obtained will not be equal to one obtained from two good chronometric meridian distances.

The only manner in which these personal errors can be satisfactorily eliminated is by the observers changing ends.

21. Observations for latitude.—Latitudes can only be satisfactorily determined from circum-meridian altitudes of pairs of stars at closely similar altitudes, using the artificial horizon; the result by one good pair, so selected and so observed, is worth more than the mean result by any number of irregularly-paired stars.

The value of latitudes obtained from the sun and a sea horizon is much enhanced by observations on both sides of the zenith. Whenever a latitude depends on an altitude on one side of the zenith only, the centring correction must be applied; this correction is given for all observing sextants issued by the Hydrographic Department.

Latitudes must always be rendered on the forms supplied, H.—153, which, like those for meridian distances, are to be numbered consecutively for the commission. See "*Hydrographical Surveying*" (*Wharton and Field*), page 285.

In Section VI. will be found the present accepted values of the longitudes and latitudes of various well-determined points. This list must always be consulted and used in any discussion of longitudes of other places depending upon the meridians given, as it may happen that some charts do not show the latest determinations.

22. Observations for variation on shore.—Care is necessary in selecting the spot, which must be on ground as little likely to be magnetic as possible. Volcanic or granite rocks have a marked influence on the needle, but coral is usually free from any magnetic component.

In all cases bearings of objects must be obtained all round, the compass being placed in the position of the theodolite used to observe the true bearing and the angles.

Successive observations at the same place, after a lapse of a certain time, are of great value in determining the change of variation, and also the error of the compass; but the compass must be placed on the *identical* spot in order to make certain that any local influences may affect the compass similarly.

To this end it is necessary to fill up the form S.—385, supplied for rendering the observations, with the names of enough fixed and permanent objects to enable the exact position to be recovered on any subsequent occasion, whether by the same observer or others. See “Hydrographical Surveying” (*Wharton & Field*), page 363.

23. Observations for variation afloat.—It may often happen that the local influences on shore may so much affect the result of observations, however carefully made, that the variation obtained on board the ship is of greater value, but to be so it must be properly obtained. This is only obtained by swinging the ship in a depth of 50 fathoms or more, if possible, and observing on at least eight opposite graduations.

If the ship is steamed round, and the sun observed on eight opposite graduations, a very accurate determination of the variation is readily obtained; but the ship should be swung twice, viz., to starboard and to port, the mean of the two results being taken.

These observations must be rendered in full, and every opportunity of making them must be taken, as it is only by such observations that the lines of variation over the water can be gradually brought to a condition of accuracy and kept corrected for secular change.

24. Coastlining.—Coastline, except in the most rapid and cursory surveys, must always be walked over when its nature permits. Many small river mouths and streams have been missed by the practice of pulling along the coast and only landing here and there.

25. Rivers, navigable either by ship or boats, must be traced as far as circumstances permit, and the best line in over the bar ascertained.

26. **Landing places.**—Landing places on coasts only accessible in places must be noted.

27. **Hidden dangers.**—For rocks, mud-flats, and sandbanks that dry only at certain times of tide, the datum is to be the same as for the reduction of the soundings, viz., mean low water springs. The height of these above this datum are therefore to be given either as “dries so many feet,” usually applied to rocks or an isolated sandbank, or in the case of extensive sand or mud flats, in underlined figures on the parts which uncover, indicating feet above the same datum. No other system is ever to be used as it tends to confusion.

28. **High water line in British isles.**—As the high water line on the Ordnance sheets of England, Wales, and Ireland is the high water mark of ordinary tides, i.e., mean tides, or halfway between springs and neaps; when surveys on those coasts are undertaken, care is to be taken that the high water line as given on the Ordnance sheets is re-surveyed if necessary; this is particularly important with a shelving beach.

The coastline on Ordnance sheets of the coast or harbours of Scotland need only be checked and amended if necessary, as on such sheets the high water line given is that of spring tides.

29. **Height of coastline and rocks off.**—The height of all land bordering the coast must be ascertained and marked, no matter if the elevation be but small, and particularly every small islet and rock which shows its head above water, must have its height noted at the time. Cliffs must also have their heights noted, and their colour if in any way remarkable. See “Hydrographical Surveying” (*Wharton & Field*), page 185.

As the tide rises or falls, the time must be noted at which rocks and various parts of the shore cover and uncover. Every part of the survey should be seen at least once at low water.

30. **Topography.**—Topography sketched from the ship, as is often necessary, must be broadly delineated. The distance inland from the coast to which the topographic feature should be shown must depend on circumstances, but the broad rule is that everything visible from the sea should be plotted; in many cases, however, this is difficult to carry out, as in the case of lofty mountains, fronted by lower ranges, at a distance from the coast. When possible, a few expeditions inland to peaks will afford to the Surveyor an opportunity of sketching in the main features of such country with sufficient exactitude. But when this is, as is frequently the case, impossible, an attempt to sketch from a distance the direction of the ranges, valleys, and spurs is a difficult and frequently a delusive task. In cases where a trustworthy map of the country exists it may very often be of great service in assisting in sketching the topography.

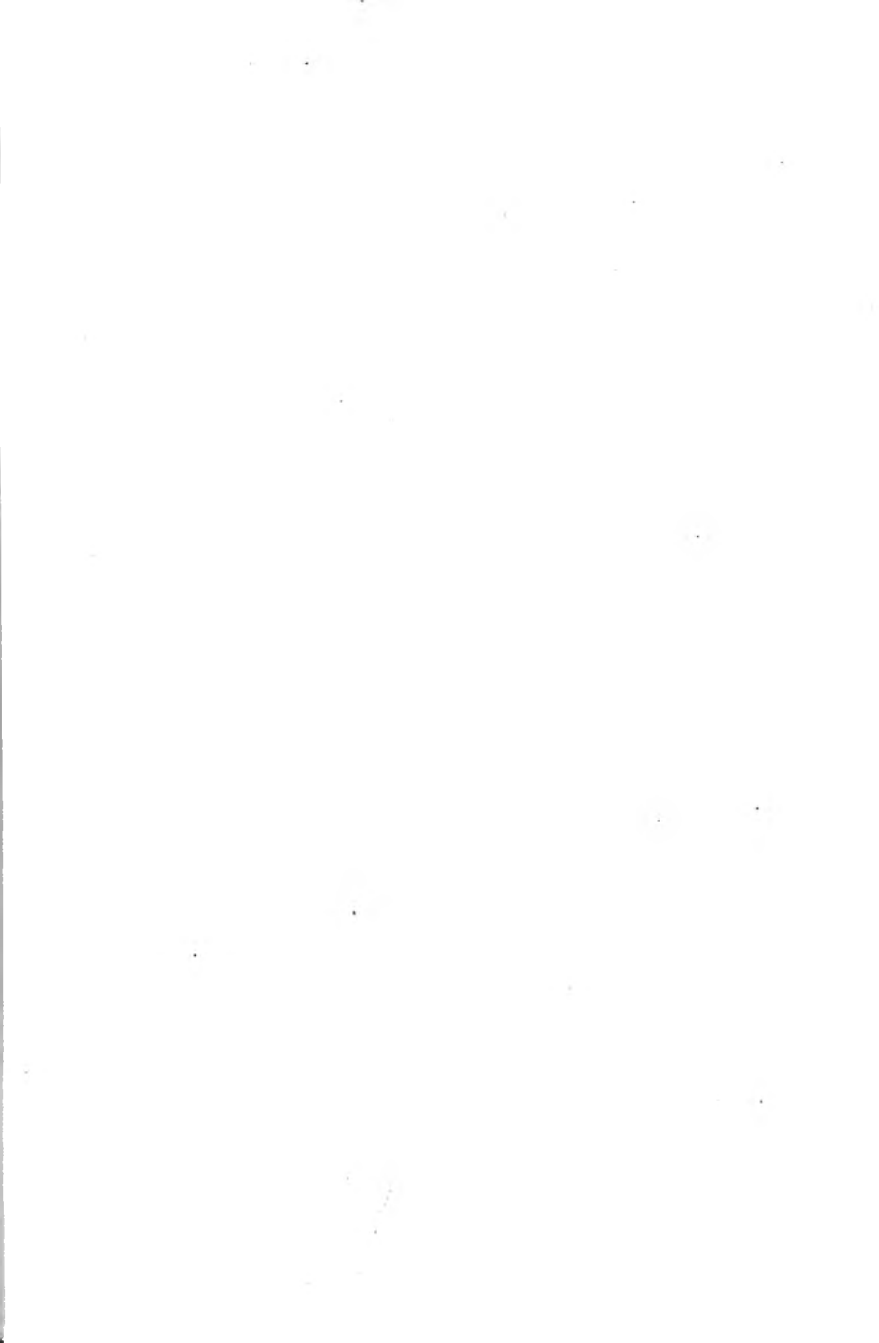


Plate No. 3.
(To face page 57.)



Broadford hotel.

Pier. Ben Dearg Beg.

Ben na Caillich.

Broadford hotel in line with summit on southern slope of Ben Dearg Beg, S. 76° W.

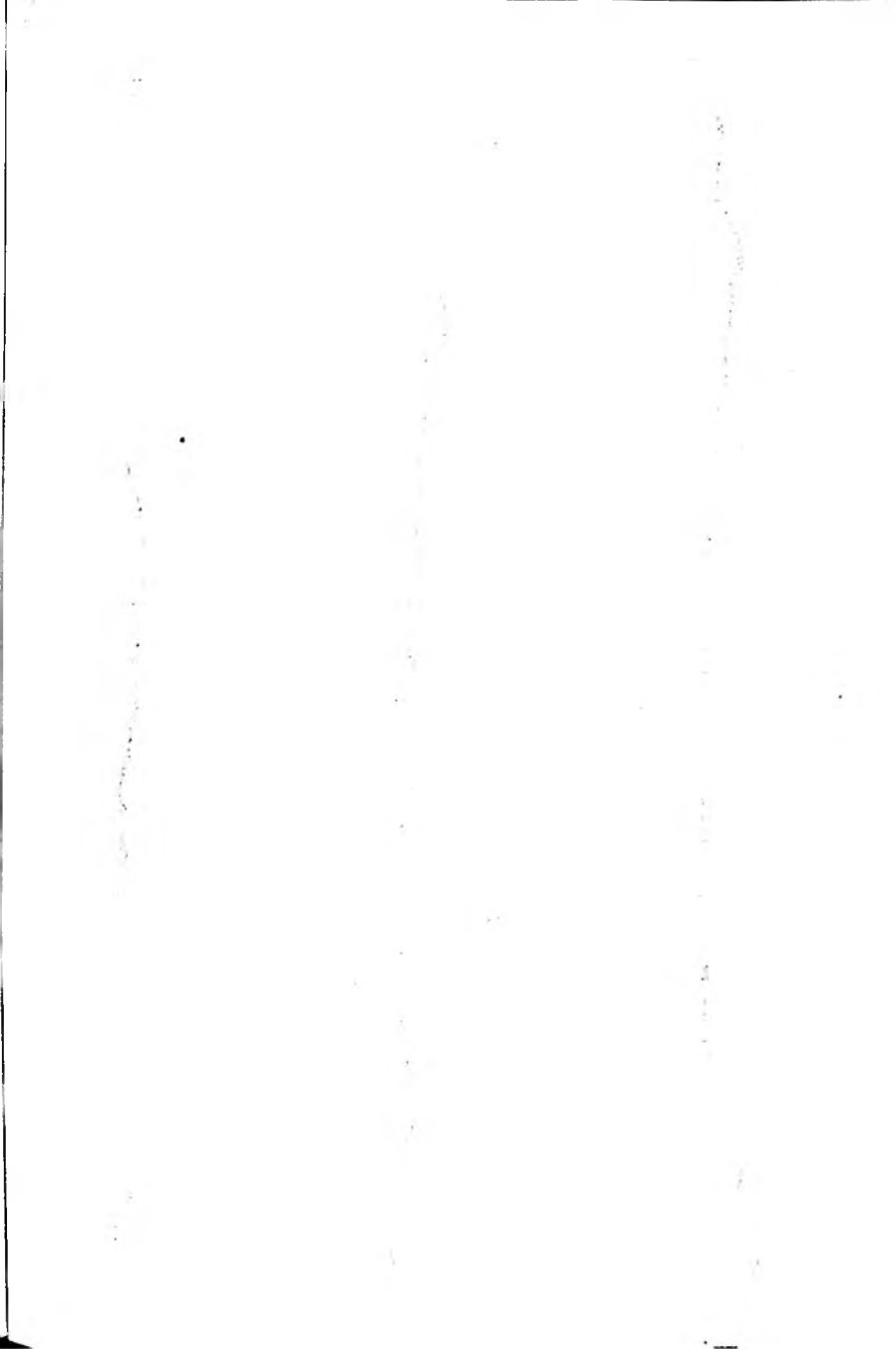


Plate No. 4.
(To face page 37.)



31. **Conspicuous objects.**—The positions of all objects which may serve as marks must be fixed. Villages, churches, mosques, pagodas, windmills, and natural marks, such as isolated clumps of trees, are especially valuable.

32. **Fixing floating navigational marks.**—When fixing light-vessels, buoys, &c., it must be borne in mind that the position required is that of the moorings, and not of the floating mark itself. As a general rule the best time of fixing a buoy is slack high water, but in the case of light-vessels all that is necessary is to fix her position, making due allowance for the bearing and distance of her anchor, which can always be ascertained on the spot. These points require special attention when the scale of the survey is at all large.

33. **Projection of data.**—All field work, whether soundings, coastline, or topography, must be plotted on the spot. Conditions may sometimes render this impossible, but it is essential that the work should be plotted as soon as possible, whilst all the facts connected with it are fresh in the mind of the Surveyor.

34. **Views.**—Good views are often of great value. They must be taken at the distance and from the direction at which they will be of most service for the particular object for which they are intended.

Few Surveyors can make an extended sketch true to scale, without angles to help them. Sketches have frequently been rejected through neglect of this practice, as, though it is easy to test their accuracy in this direction by measuring the angles on the chart, both horizontal and vertical, it is not so easy to redraw a sketch to correct these errors. In views of distant low land it is usual to employ a scale for the vertical height one-third greater than that for the horizontal angular distances. The new Surveying Sketch Book, H.—12, has been specially designed with squared paper to enable sketches to be made in proportion.

Plates Nos. 3 and 4 are examples of views and the amount of detail shown thereon is generally sufficient for all navigational purposes (*see* also page 74, Section IV.).

Sketches of lighthouses and beacons should always be made when practicable.

35. **Leading lines and clearing marks** must always be actually run; this is especially important in the case of incomplete surveys.

36. **Photography.**—In the present day, when the practice of photography is so much simplified, written descriptions of headlands and other prominent features of the coast might often usefully be supplemented by photographs, which could be reproduced in the Sailing Directions.

The negatives, with full particulars as to distance and direction from the coast at which the photographs were taken, should be forwarded to the Hydrographic Department, to be dealt with as considered desirable.

37. Information on natural history or other scientific subjects.—The Surveyors should endeavour to collect any specimens that may tend to the perfection of the national collections. There are Manuals of Scientific Enquiry which contain, under the head of Botany, Zoology, and Geology, many hints as to how best to further these objects. Oceanic islands are seldom without their especial fauna and flora, and observations upon these phenomena are always of use to scientists at home occupied in investigations upon the history of the globe.

The British Museum is always ready to provide collecting cases and tanks when there is any probability that they will be utilised. It is very seldom that any collection of specimens from little known parts of the world does not contain some objects new to science, and the most insignificant insects or animals are often most valuable.

Specimens of rock from all little known shores should be collected and labelled with the locality where obtained. These are especially valuable from oceanic islands, which, though generally of a volcanic origin, comprise some remarkable exceptions.

Boxes of typical geological specimens are now supplied to all surveying ships on foreign stations.

It should also be borne in mind that surveying officers are frequently brought into contact with savage races and tribes about whom little is known.

Observations upon their customs, religious and civil ceremonies, folk-lore, dress, physical and moral qualities, &c., are often of great service to the anthropologist, and naval officers in the past have frequently advanced the cause of science by their notes and observations upon the natives of the places they have visited; phonographs have been used, with great success, to record savage speech and music.

The Royal Anthropological Institute issue a form to all travellers giving particulars of useful information which can be obtained by people with no previous training or knowledge.

SECTION IV.

DRAUGHTSMANSHIP.

1. **The fair chart.**—The drawing of the fair chart is a work in which the utmost care must be observed, so that the smallest details are clearly laid down with precision and accuracy. Moreover, as it is a relaxation from the more arduous duties of the Surveyor in the field, inasmuch as the time allowed for its drawing is generally more than ample, the artistic capabilities of the Surveyor should be encouraged and have free scope, being restricted only by the instructions for the representation of the various details as set forth hereafter. These must be strictly adhered to, as it is only by following them that a faithful photographic reproduction of all details on the fair chart can be ensured; this is an essential point, as it is now generally the practice of the Hydrographic Department to reduce fair charts to smaller scales by photography.

Scales.—The scale on which a survey is made is generally communicated by the Hydrographer, the leading rule being that the chart must show all the necessary details of the coast, &c., corresponding to the area charted. The scale on which it may afterwards be expedient to publish the survey rests entirely with the Hydrographer, and depends on a variety of circumstances, but due consideration is always given to the remarks on this point made by the Surveyor in his "Annual Report of Survey."

It must, however, be borne in mind when scheming the limits of any chart that the Admiralty charts are generally published either as sheets known as Double Elephant, of which the engraved portion, within the inner margins of the graduation, measures 38 inches by 25 inches, or as sheets known as Half Double Elephant, of which the engraved portion, within the graduation, measures 25 inches by 18 inches.

Time is sometimes wasted by surveying on too large a scale irregularly shaped areas, which cannot be published on a Double Elephant sheet without reducing the scale, or making it necessary to complete the published chart by adding to it from old or imperfect data; this fact must not be overlooked.

Graduation.—All charts are to be graduated on the Gnomonic Projection, *see* "Hydrographical Surveying" (*Wharton & Field*), page

383, and "Table for the Graduation of Surveys and Charts on the Gnomonic Projection," a copy of which latter is issued to every Surveyor in the "Tables for use in Construction of Charts." The only exceptions to this are surveys out of sight of land of a scale of under 2 inches to the sea mile, which are to be graduated on the well-known Mercator's Projection.

The Gnomonic chart is to be graduated on two triangulation stations, the positions of which have been calculated, and these are to be chosen so as to be, both in latitude and longitude, as far apart as possible. The graduation must also be checked by any other calculated positions. Chart X.19, supplied to all surveying ships, shows the style of graduation, &c., and is to be strictly adhered to.

Meridians.—When drawing the true meridian on a fair chart it is always to be drawn through a main station or astronomical observation spot.

The magnetic meridian is never to be drawn.

Compass roses are never to be drawn on a fair sheet or tracing.

Sizes of fair charts.—Fair charts are not to be forwarded on very large sheets, the limit of the size being 6 feet by $3\frac{1}{2}$ feet. It sometimes occurs that the survey covers more paper than this, in which case the points should be transferred to sheets not larger than the above, overlapping one another sufficiently to provide connecting points, which may, if necessary, be assumed ones.

Paper to be used.—The paper on which the fair chart is drawn is to be the linen-backed paper supplied.

Care of drawing paper.—Every care is to be taken to keep the paper in as dry a place as is possible, but it often becomes hairy and therefore troublesome to work upon, especially if at all old or if the climate is at all humid. This defect may sometimes be remedied by passing a hot iron over the paper, care being taken to interpose a dry sheet of thin paper between the face of the iron and the paper under treatment.

Colours to be used.—Colour washes may be used, but the tints should be *as light as possible*, and the only colours permissible for washes are those given in the following list. Too great elaboration in working up sand or mud flats, low water rocks, coral, &c., is to be avoided; this is especially the case where the low water line is in close proximity to the high water line. Indian ink is generally to be used for all details on the fair chart, but the following colours are to be used in depicting various features in order to distinguish them more clearly. The remarks as to the application of colours, &c., must be carefully studied and followed.

COLOURS TO BE USED.

Objects to be represented.	Colours to be used.	Remarks as to application of colour.
Arbitrary or Assumed points.	Prussian green -	For connecting overlapping sheets. Circles of 0.2 inch diameter.
Breakers -	Red - - -	
Bridges, stone or iron.	Red - - -	
" wood -	Black - - -	
Coral (drying reefs)	Light red, burnt sienna.	Burnt sienna pale wash, burnt sienna and light red pen work for shading.
Cultivation -	Prussian and Hooker's green No. 2.	Hooker's green pale wash, prussian green pen work.
Current arrows	Red - - -	Length 0.4 inch.
Dredged area -	Neutral tint or Payne's grey.	Very pale wash, breaking blue water tint if necessary. (See also limits of dredged or swept areas.)
Eddies -	Red - - -	
Fathom lines -	Red - - -	Continuous firm line for 1, 3, and 5 fathom lines, above these the recognised symbols.
Fixed marks used during survey.	(Red - - - (Black - - -	Circles of 0.1 inch diameter. Very small black circles; also used where it is desired to represent spires, beacons, &c.
Fixed trigonometrical stations.	Red - - -	Circles of 0.2 inch diameter surrounding a triangle.
Fishing stakes -	Red - - -	
Gravel -	- - -	SEE Stones.
Grass land -	Prussian green -	
Heights above H.W.	Red - - -	Upright figures, no brackets.
" " L.W.	Black - - -	Upright or sloping figures, underlined in black.
Hill contours -	Grey, neutral, or black.	Can be shaded by horizontal shading of the same colour, but much lighter or stippled with light washes.
H.W. line -	Black - - -	Continuous firm line.
Houses and buildings.	Red - - -	Pale red wash shaded with dark red, small isolated buildings dark red only.
Kelp -	Indian yellow -	
Lakes -	Prussian blue -	Pale wash, black outline.
Land tint -	Burnt sienna, Hooker's green No. 2.	Very pale washes only allowed.
Letters for trigonometrical stations.	Red - - -	Capitals for main stations, small for other stations.
Leading lines, &c.	Red - - -	Firm continuous as far as line is to be used, but dotted where prolonged to the objects.
Limits of dredged or swept areas.	Red - - -	Light pecked line.
Long side -	Red - - -	
L.W. line, sand or stones, &c.	Red - - -	Continuous firm line.
L.W. line, mud -	Black - - -	Pecked line.
Mangroves -	Prussian green -	Pale washes to represent the mangrove and dark pen work, edges of mangroves to be shown in blacked pecked lines.
Marsh -	- - -	SEE Swampy ground.
Mud (low water) -	Payne's grey	Regular dotting. (SEE also L.W. line, mud.)
Meadows -	- - -	SEE Grass land.
Observation spot -	Red - - -	Cross thus +
Piers, stone or iron	Red - - -	
" wood -	Black - - -	
Railways -	Black - - -	Continuous firm line with very short lines at right angles.
Reefs (rocky ledges)	Raw sienna -	Pale wash and black pen work for shading, also for rocks.
Rivers -	Indigo - - -	Stream by a line, where it is broader a double line and may be washed with prussian blue

COLOURS TO BE USED—continued.

Objects to be represented.	Colours to be used.	Remarks as to application of colour.
Roads - - -	Burnt sienna -	<i>Pale wash and dark double lines for shading. SEE Reefs.</i>
Rocks (low water) -	Black - - -	
Sand (high water) -	Indian yellow -	<i>Regular dotting. (SEE also L. W. line, sand.)</i>
" (low water) -	Black - - -	
Sandhills - - -	—	<i>SEE Kelp.</i>
Seaweed - - -	—	<i>SEE Stones.</i>
Shingles - - -	Burnt sienna	<i>Pale washes to represent the stones, &c., shaded with dark colour. (SEE also L. W. line stones.)</i>
Stones (below H. W. line).	—	<i>SEE Rivers.</i>
Streams - - -	Prussian blue -	
Swampy ground -	Red - - -	<i>Fair-sized dot. SEE page 68 as to when to be used.</i>
Summits - - -	—	<i>SEE Dredged areas.</i>
Swept areas -	Red - - -	<i>Length 0.4 inch and when parallel 0.1 inch apart.</i>
Tidal stream arrows	Red - - -	
Tide rips - - -	Red - - -	
Tracks over bars, &c.	Red - - -	<i>Pecked lines, when the tracks have been run.</i>
Trees - - -	Hooker's green No. 2.	<i>Very pale wash to represent the trees, shaded with dark colour.</i>
Water tint - - -	Cobalt - - -	<i>Dark from L. W. line to 1 fathom line, light between 1 and 3 fathoms and blue ribbon decreasing in colour from the 5 fathom line towards the 3 fathom line.</i>
Writing - - -	Black - - -	<i>WITHOUT exception all descriptive writing and names are to be in black.</i>

NOTE.—The word "firm" in the remarks column is used to indicate a fairly heavy line in distinction from a light one.

The signs and abbreviations as given on Admiralty chart "Signs and Abbreviations" X.11. are invariably to be followed.

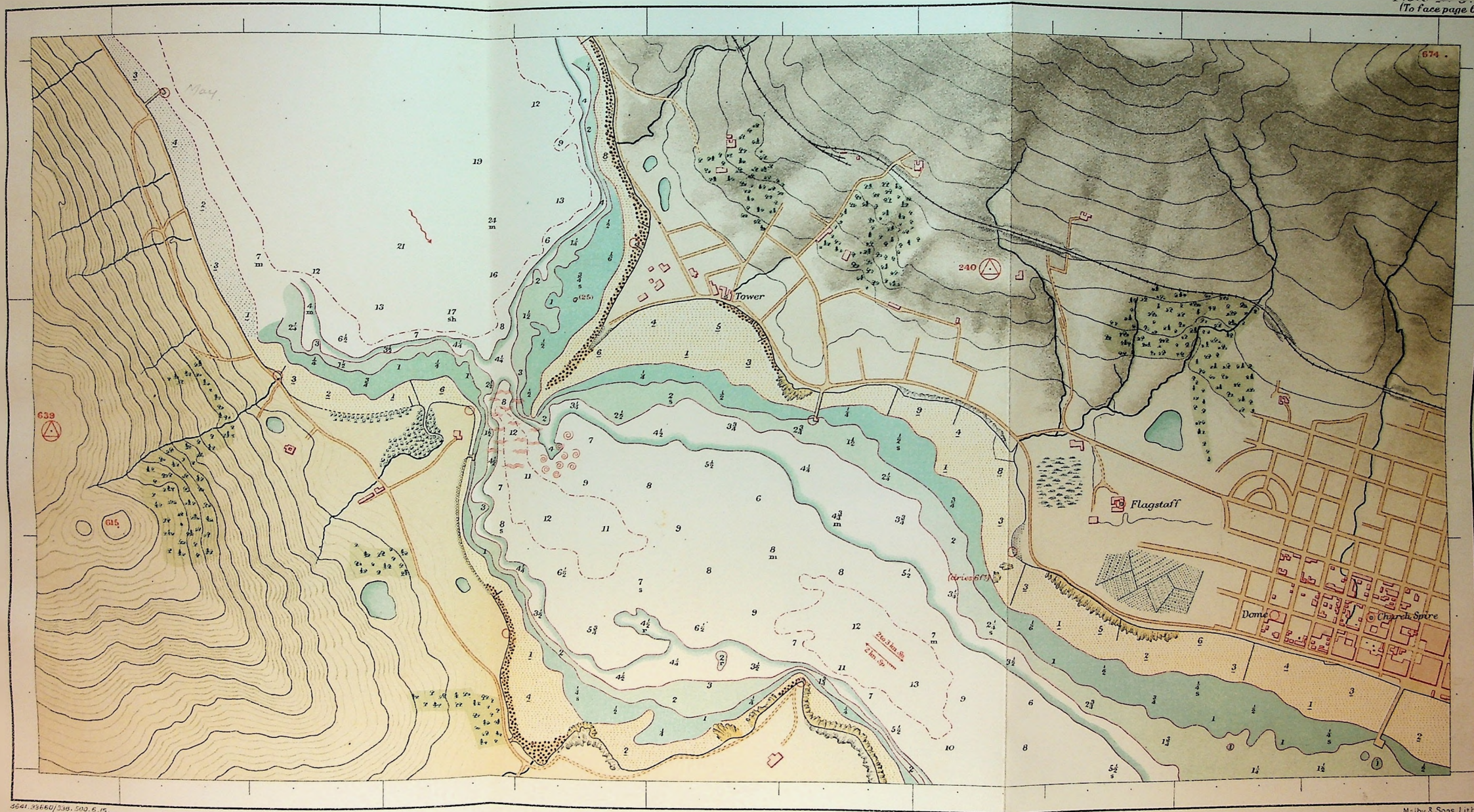
The accompanying coloured reproduction of a portion of a fair chart, Plate No. 5, shows the method of colouring to be adopted in representing the various details, and Plate No. 6 shows a photographic reproduction of the same, in which it will be observed that no necessary details are lost in photographing when the above specified colours are used.

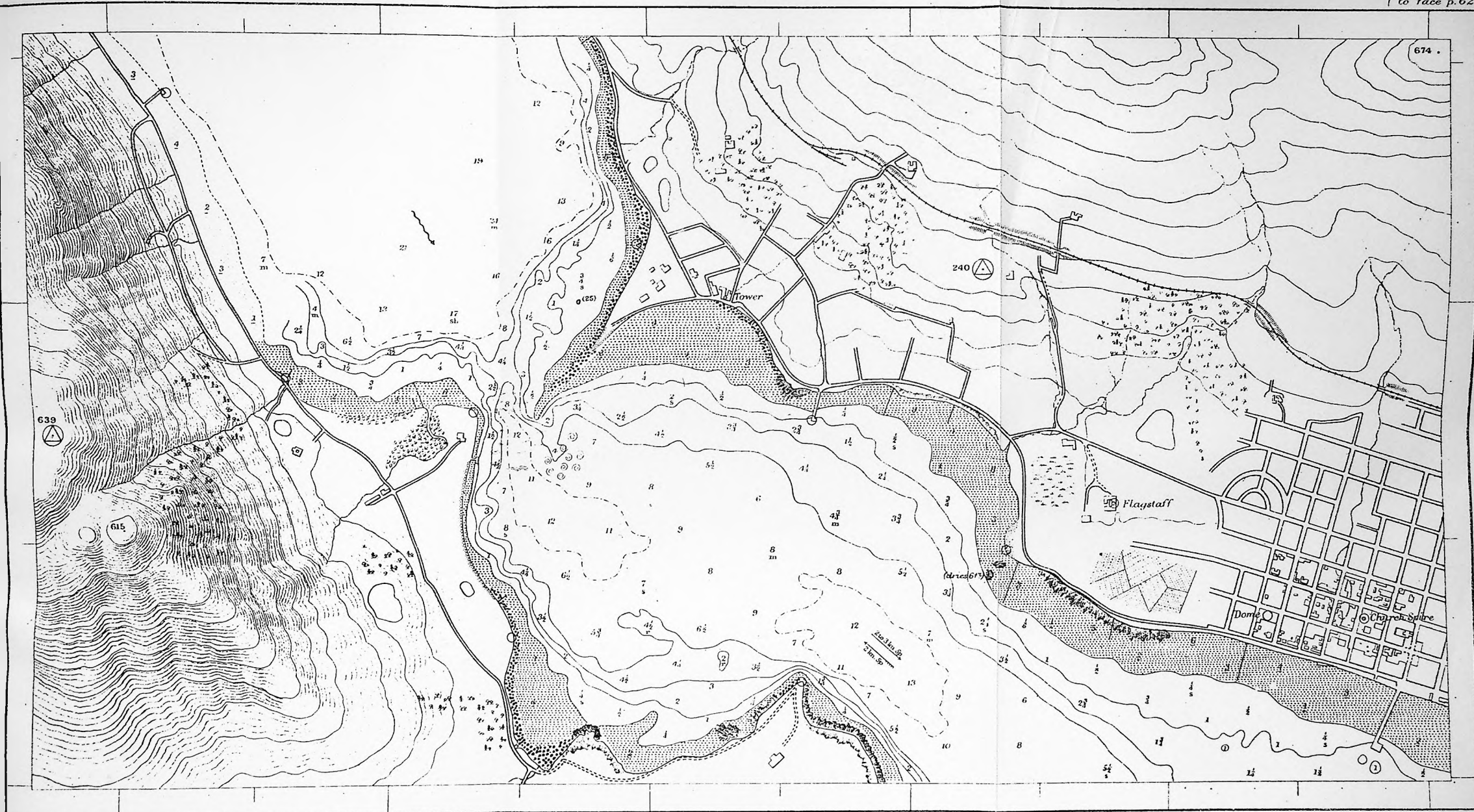
Mode of writing on the fair chart.—Nothing tends to enhance the appearance of the completed drawing more than a systematic method of lettering. Different characters are to be used for different objects, and the writing must be horizontal or curved as necessary. Plate No. 7 clearly shows the correct curvature to be adopted, the incorrect curvature also being shown on Plate No. 8.

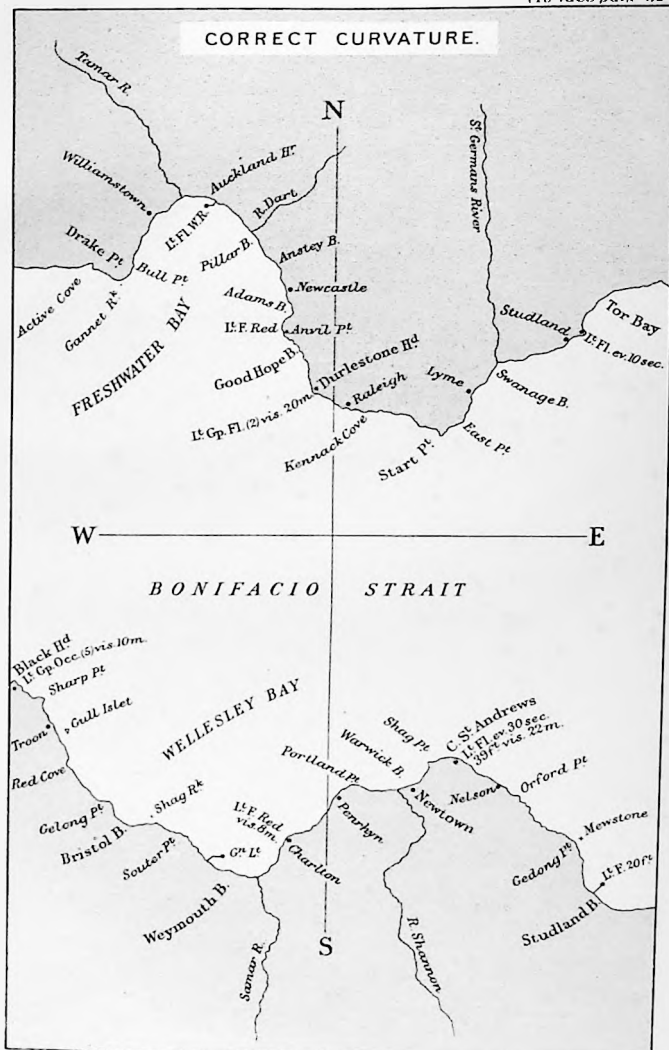
Styles of lettering on the fair chart.—The various styles of lettering to be adopted are shown on Plate No. 9, and is to be used as follows:—

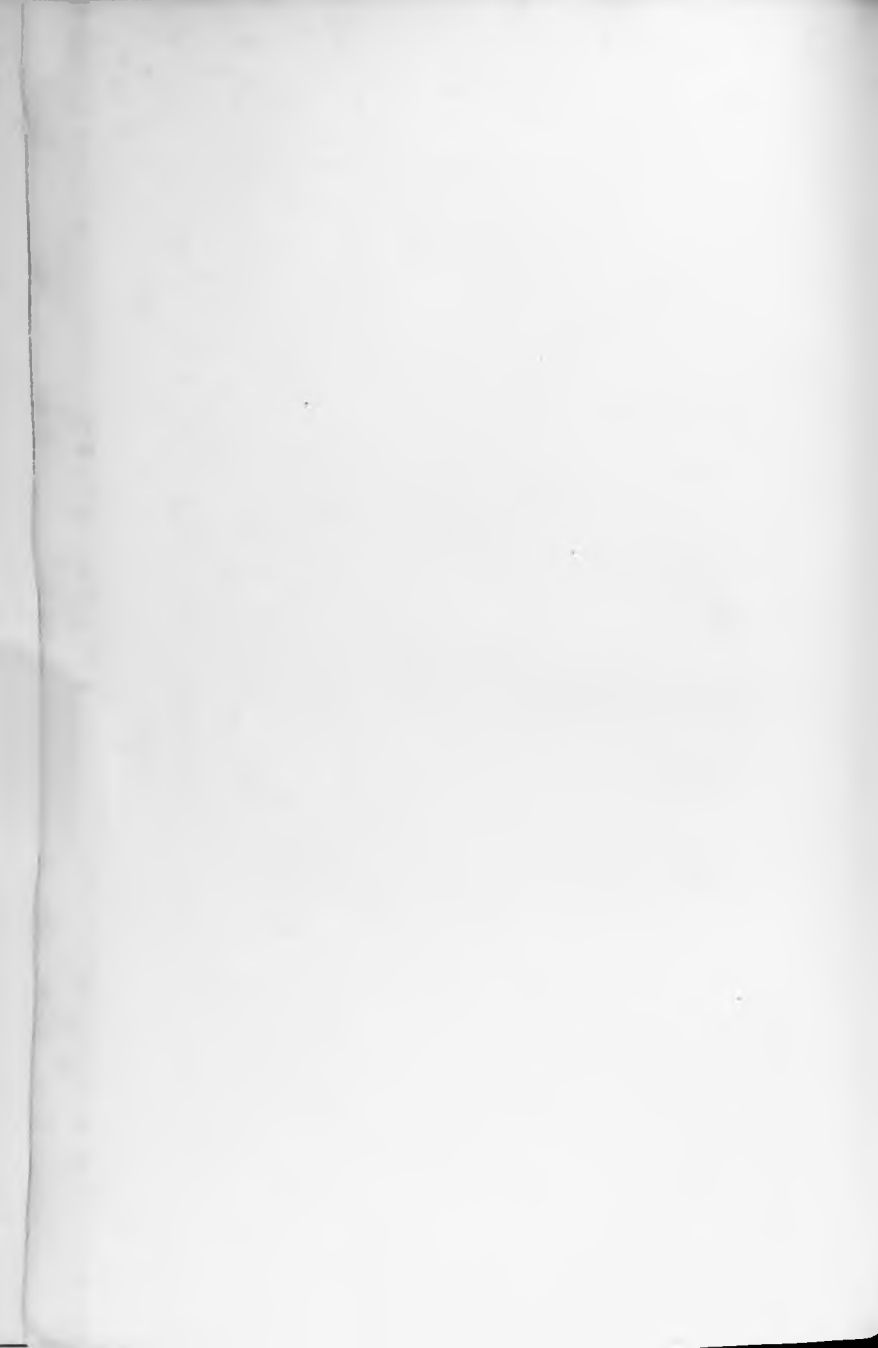
EXPLANATION AND USE OF THE VARIOUS STYLES OF LETTERING. See PLATE No. 9.

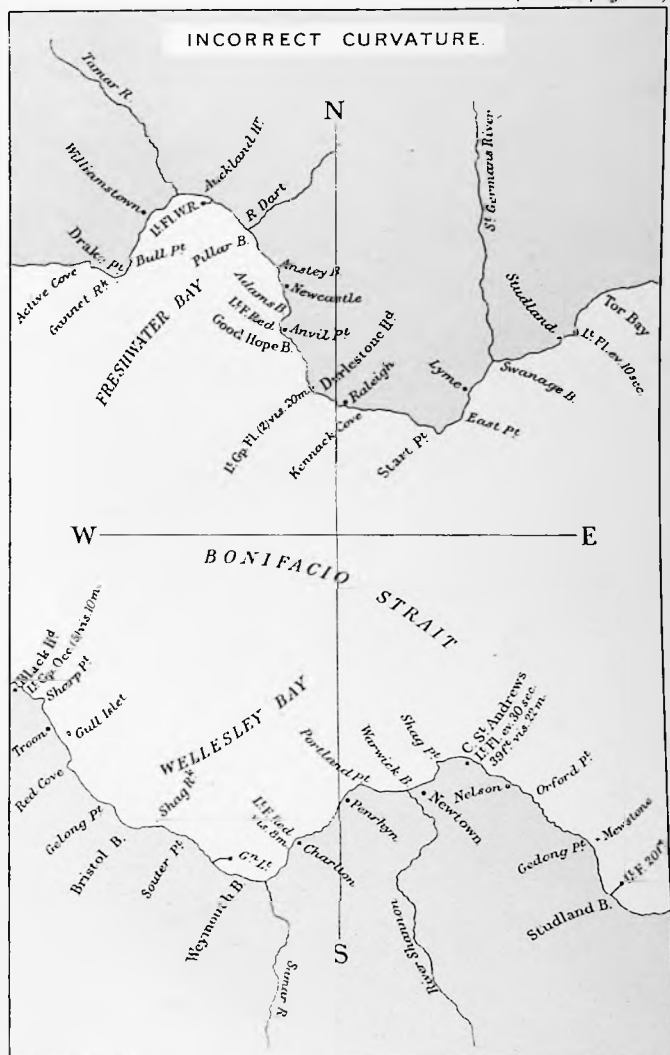
DOUBLE STONE, ORNAMENTED.—All words written in this character to be capitals. To be used for titles of large fair charts.











Names and Styles of Lettering.

Double Stone Ornamented

A B C D E F G H

Double Stone Shaded

A B C D E F G H I J K

Single Stone Shaded

A B C D E F G H I J K

Single Stone Open

A B C D E F G H I J K

Roman Ornamented

A B C D E F G H I J K L M N

Roman Shaded

A B C D E F G H I J K L M N

Roman Clarendon & Clarendon Print

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz

Roman Black

ABCDEFGHIJKLMNOPQRSTUVWXYZ

Roman Black Sloping

ABCDEFGHIJKLMNOPQRSTUVWXYZ

Roman Numerals

I II III IV V VI VII VIII IX X XI XII

Egyptian Capitals

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Egyptian Print

abcdefghijklmnopqrstuvwxyz

Egyptian Stamp

abcdefghijklmnopqrstuvwxyz

Print

abcdefghijklmnopqrstuvwxyz

Stamp

abcdefghijklmnopqrstuvwxyz

Hair line Print & Stamp

abcdefghijklmnopqrstuvwxyz

abcdefghijklmnopqrstuvwxyz

Numerals

0 1 2 3 4 5 6 7 8 9 $\frac{1}{2}$ $\frac{3}{4}$ 0 1 2 3 4 5 6 7 8 9 $\frac{1}{2}$ $\frac{3}{4}$

DOUBLE STONE, SHADED.—All words to be in capitals. To be used for titles of smaller fair charts.

SINGLE STONE, SHADED.—May be used in place of the above, or for smaller fair charts and insets thereon. All in capitals.

SINGLE STONE, OPEN.—Instead of Single Stone, Shaded. All in capitals.

ROMAN ORNAMENTED.—For small fair charts, in place of the two next above if desired. All in capitals.

ROMAN SHADED.—If desired in place of Roman Ornamented. All in capitals.

ROMAN CLARENDON AND CLARENDON PRINT.—For titles of small fair chart in lieu of above. All in capitals. In capitals and print for all conspicuous objects and lists of conspicuous objects.

ROMAN BLACK.—For all principal names on the land, on the sea of large islands, or on the islands themselves, on large scale fair charts. All in capitals.

ROMAN BLACK SLOPING.—For names of important seas, gulfs, bays, rivers, estuaries, straits, lagoons, or other parts of the sea.

ROMAN NUMERALS.—For high water, full and change, with the exception of two hours, when the Arabic 2 should be used to prevent any confusion between it and eleven hours.

EGYPTIAN CAPITALS.—For all large patches of shoal water, sandbanks, rocks, vigias, and railways.

EGYPTIAN PRINT.—For smaller patches of shoal water, or large patches of shoal water on small scale fair charts, and railways. The first letter of every name is to be in Egyptian capitals.

EGYPTIAN STUMP.—For shoals, rocks, and vigias, where space does not permit of using the above, and on small scale fair charts. The first letter of each name to be in Egyptian capitals, but sloping.

PRINT.—Each name to commence with a Roman Black. To be used for the lesser important names of villages, capes, points, bays, coves, rivers, &c.

STUMP.—For all unimportant names and writing. Names to commence with a Roman Black Sloping.

HAIR LINE PRINT AND STUMP.—For notes, descriptive words, and names, and all writing in connection with work of a sketchy or approximate character either on land or water.

Fathom contour lines.—The only contour lines that need be shown are 1, 3, 5, 10, and 100, but if considered necessary the 20, 30, 40, 50, 60, 70, 80, 90 may also be shown.

Soundings.—All soundings obtained are to be shown if possible, the size of figures being decreased if necessary over shoals, &c. Otherwise the size of the figures are to be the same throughout the sheet. The style of figures may be either sloping or upright as shown on Plate No. 9, but it is observed that the sloping figure is more legible, and is for that reason now generally adopted on the Admiralty charts.

The reduction of soundings has already been given in Section III. In plotting the soundings quarter fathoms are to be shown when the sounding is under 7 fathoms, but only half fathoms between 7 and 11; over 11 fathoms no fractions are to be shown.

For example: $7\frac{1}{4}$ and $7\frac{3}{4}$ are to be shown as 7 and $7\frac{1}{2}$, respectively.

$11\frac{1}{4}$, $11\frac{1}{2}$, and $11\frac{3}{4}$ „ „ 11, 11, and 12, respectively.

In plotting soundings under one foot (*see* Section III., page 43), if the sounding is 1 inch to 3 inches inclusive, it is to be shown as awash, if rock, by the usual symbol, if a detached bank by single dots, thus $\cdot\cdot\cdot$, or the area on the chart may be left blank, according as it is an isolated shoal or the depths between the low water line and the one foot line.

Qualities of the bottom are to be freely interspersed amongst the soundings, the recognised abbreviations (Chart X.11) being used. If the bottom throughout a survey is of uniform character it will be sufficient to insert a note to this effect, and if the closeness of the soundings prevents the qualities of the bottom being shown a cloth tracing is to be forwarded showing them. When the quality of the bottom is found to be in layers, it is to be so shown, *e.g.*, “ m. over s.”; if space does not allow this, the fact is to be inserted in the form of a note on the chart, and it is also to be noted in the Sailing Directions (*see* Section V., page 78).

Tidal streams on the fair chart.—

- a. Where the information is indefinite, *i.e.*, where only the direction of the flood and ebb stream, and possibly the mean rate, are known, insert at the position the flood and ebb arrow with the rate, the length of the arrow being 0.4 inch, and, when parallel, 0.1 inch apart.

NOTE.—The use of flood and ebb arrows is to be limited to when the stream changes within one hour of high and low water at the spot.

- b. When the information is such that the time of turn of stream is known and possibly the general direction and rate, insert at the position affected thus:—

<i>East-going stream begins about</i>	<i>hours after H.W. at</i>
<i>West „ „ „ „</i>	<i>„ before „ „ „</i>
<i>Maximum rate in knots observed at springs and neaps.</i>	

If space does not permit this to be inserted at the position, insert at position a circle and letter *in hair* with note "See note on Tidal Streams," thus:—

Ⓑ See Note on Tidal Streams;

and then in a convenient position on the land, or where it will not interfere with other important work, insert thus:—

At { East-going stream begins about hours after H.W. at
 Ⓑ { West " " " " " before " "
 Maximum rate observed at springs and neaps.



c. When all information is definite and available, a circle and letter with note is to be inserted at the position, thus:—

Ⓑ See Table of Tidal Streams;

and then, somewhere convenient, a tabulated summary, thus:—

Hours.		Position B.	
		Direction.	Average Rate Observed. Stating whether Springs, Neaps or Otherwise.
Before H.W., Dover	5	—	Slack.
	4	233° (S. 67° W. Mag.)	0 to 1½ knots.
	3	233° (S. 67° W. Mag.)	½ to 2 "
	2	233° (S. 67° W. Mag.)	½ to 1½ "
	1	233° (S. 67° W. Mag.)	½ to 1½ "
H.W.		233° (S. 67° W. Mag.)	½ to 1½ "
After H.W., Dover	1	—	Slack.
	2	53° (N. 67° E. Mag.)	0 to 1½ "
	3	53° (N. 67° E. Mag.)	½ to 2 "
	4	53° (N. 67° E. Mag.)	1 to 2 "
	5	53° (N. 67° E. Mag.)	½ to 1½ "
	6	53° (N. 67° E. Mag.)	½ to 1 "

d. Or else insert plans showing graphically the hourly directions and rates, instead of b. and c.

e. No arrows are to be shown except as mentioned in a. Currents, so as to make them clearly distinguishable from tidal streams, are to be shown thus:  instead of  as formerly. They are to 0.4 inch in length.

f. On all fair charts the tidal streams are to be referred to the nearest standard port, except where there is no standard port sufficiently near, in which case the stream should be referred to the shore.

g. Under the title of the fair chart, or failing space in some other suitable position, the approved tabular form of "Tidal Information" is to be given as follows:—

1. The name of *place*.

2. The Vulgar Establishment (*H. W. F. & C.*) according to the best available determination.

3. The mean *rise* of the Tide at Springs and at Neaps *above*

the datum of the Soundings, on the chart to the nearest $\frac{1}{4}$ foot according to the best available determination.

4. The mean range of the Tide at Springs and at Neaps to the nearest $\frac{1}{4}$ foot according to the best available determination.

5. The datum to which Soundings are reduced referred to:—

(a) Ordnance Datum or other Fixed Mark exactly.

(b) The Level of Mean Low Water Springs approximately.

(c) The Mean Tide Level approximately.

The term *Low Water ordinary Springs* will not, in future, be used, the datum which has hitherto been referred to in these terms being now called "*Mean Low Water Springs*."

As neither the level of Mean Low Water Springs nor the Mean Tide Level can be exactly ascertained except from a very prolonged series of tidal observations, the datum to which Soundings on the chart are reduced with reference to these levels is always to be given as approximate.

It will be seen that when the datum of the charts is approximately Mean Low Water Springs, the rise and range of spring tides will be equal. When, however, the datum is other than Mean Low Water Springs, Spring rise will indicate the mean height of High Water Springs above the datum of the Soundings on the chart, and Spring range the mean height of High Water Springs above the level of Mean Low Water Springs. Moreover, in either case the Neap rise will indicate the mean height of High Water Neaps above the datum for Soundings on the chart, and Neap range the mean height of High Water Neaps above Mean Low Water Neaps.

The following is an example of tidal information, tabulated in accordance with the foregoing:—

Tidal Information

Place	H.W.F. & C.	Rise above datum of Soundings	Range	Datum to which soundings are reduced
	XI ^h 58 ^m	Springs 12 ^h feet Neaps 12 ^h ...	Springs 11 feet Neaps 7 ^h ...	41' 7" below Ordnance datum or 13' 7" below benchmark 4 set on North Wing of Battery at North end of Esplanade or approximately 15' below the level of Mean Low Water Springs 62' 7" = Mean Tide Level

Currents are not to be shown on the fair chart unless permanent in direction and force for some definite and prolonged period, e.g., S.W. monsoon.

Breakers.—The information that a danger shows itself by breakers is often of great value to the navigator, and the note "breaks," "breaks in heavy weather," "breaks at half tide," &c., as the case may be, must always be written against such dangers.

River bars.—The best line in over a bar when ascertained is to be shown on the fair chart together with the date.

Leading lines and clearing marks, shown on the fair chart, are to be invariably sounded over and the soundings shown. (See Section III., page 57.)

Overfalls, tide-rips, and eddies are to be shown by the recognised symbols, with a note as to their dangerous character if necessary.

The coastline must be drawn in with a firm continuous line of equal thickness, clearly distinguishable from the low water line or other low water features, and every care must be taken in transferring it from the fair tracings.

When it is desired to take coastline and topographical details from ordnance maps the method to be employed is as follows:—

The original chart is to be graduated gnomonically on positions obtained from the ordnance survey, or failing these on positions taken from the 6-inch ordnance map. The details of the coastline and topography are then to be transferred to the original chart by similar latitude and longitude areas, care being taken to notice if any discrepancy exists between the astronomical or geographical positions of the main triangulation stations and the fixed points as shown on the original chart and the ordnance maps.

Wooded hillsides, cultivation, marshy land, trees, grass, and mangroves.—These may be indicated by written remarks, but the recognised symbols can also be used, and in some cases this is essential; for instance, with a mangrove shore, cultivated hillside presenting a good clearing mark, gaps in trees or tree clumps, &c.

Cliffs must invariably have their heights given, and should be clearly shown, for they are often very imperfectly shown on maps; where their colour differs from their surroundings it is to be given.

Spires or towers of churches and other conspicuous features of buildings are to be clearly shown by small black circles, with reference to their positions as regards the remainder of the buildings on which they may be situated.

Conspicuous objects are to be distinguished by the mode of writing, and are also to appear in a tabular form under the heading "Objects on this chart conspicuous to the navigator."

Heights are to be freely interspersed as a guide to the cartographer. They are to be given above high water springs. (*See under Title.*) Where the heights are estimated or depend on imperfect observations the word "approximate" is to be inserted against them; and where the height is given to the tops of trees it should be so stated, together with the word about, thus:—"Tops of trees about 120 feet." In all cases the total height of the object above high water is to be given as well as the height above the ground.

As heights of hills, &c., can seldom be absolutely measured it is generally sufficient to give such heights to the nearest even 5 feet.

Every small islet and rock must have its height given, and heights above low water are to be shown against drying rocks, sandbanks, mud flats, &c. The term "awash" is only to be used when a danger

is awash at low water; where it is awash at any other state of tide it is to be shown as "dries so many feet."

Representation of hills and mountains.—The method of representing is best done by hachuring, but this is a very tedious method and difficult to do artistically. Other methods that may be employed are contour lines, those parts which require shading either being shaded by broken short contour lines or by a light wash, care being taken that in either case the contour lines themselves are not obliterated (*see* Plate No. 6). When the contour lines are only approximate, and not drawn in on the spot, it must be so stated in the memoir.

The contour lines on ordnance sheets do not always sufficiently emphasize conspicuous details, more especially in country which is generally low-lying. Any outstanding features are therefore to receive special attention, as, for example, cliffy contours, precipitous-sided ravines, &c.

Marking stations and summits.—All triangulation stations are to be shown in red by a triangle enclosed by a circle, the centre being the main station. The distinguishing letter against a main station is not to appear on the fair chart unless it is referred to on the fair chart. All other stations or fixed points, such as white-wash marks, are to be shown in red by a circle, the centre being the point. The summit of hills or elevations that are fixed, but are not stations or marks, are to be shown by a red dot, large enough to be distinguishable. The sizes of the circles enclosing a main station and all other stations or fixed points are to be 0·2 and 0·1 of an inch in diameter, respectively.

Observation spots.—The exact positions of the Observation spots are to be clearly marked on the fair chart by a red cross.

Nomenclature.—Distinct names to points, islands, shoals, and rocks are absolutely necessary in a chart in order to render either the log book, narrative, or sailing directions intelligible.

The Surveyor must therefore take every pains to ascertain the acknowledged or native names.

The dual nomenclature which embarrasses the geographer, and renders so many accounts of incidents obscure, frequently arises from new names being bestowed on features which already locally possess others. These latter are certain to be eventually reported, and as certain to be recognised as the true name, when it is very difficult to shake off the one already appearing on the charts without inconvenience.

When such acknowledged names cannot be obtained, then let the Surveyor freely give as many as will answer the purpose, but he must

avoid the repetition of popular names, which so much tends to confuse our gazetteers and to perplex our memories. *He must beware of meddling with names already established*—those which have been stamped upon places by the first discoverer are held sacred by the common consent of all nations—and when new ones must be given it would show better taste to make the name convey some idea of the form or character or productions of the place, or some characteristic of its inhabitants, than to exhaust the catalogue of public characters and private friends. The officers and crew indeed may have some claim to such a distinction, which, slight as it is, helps to excite additional interest in a laborious survey.

Geographical terms.—Care is to be taken that the geographical terms used for natural formations are used as correctly as possible as regards new names, but as regards old ones the rule laid down under “Nomenclature” must be adhered to, *i.e.*, to beware of meddling with names already established. The following few definitions are given to assist the surveyor and to save reference.

A *river* is a flow of fresh water which, excepting in its lower reaches, is always in the same direction, but the term *stream* is never to be used excepting as regards oceanic currents or the flow or ebb of the tide.

A *creek* may be either of fresh or salt water, but is tidal throughout its whole course.

Overfalls, rips, or eddies are the effect of the current or tide passing over an irregular bottom, whereas *breakers* are the effect of the state of the sea.

A *bay* is a comparatively slight indentation in the coastline in distinction to a *gulf, loch, firth, &c.*

A *channel* must not be confused with a *strait* or *sound*, which are comparatively narrow channels.

A *roadstead* is an open anchorage generally protected by shoals, whereas harbours and ports are those protected by land formation or artificial works.

The expression “*shoal*” should be limited to a detached area, the depths on which constitute a danger. A detached area the depths on which do not constitute a danger should be called a *bank*. A shoal area connected to the shore is not properly a shoal, but rather a spit, sand, or bank. A *reef* is always rocky, but the word is not to be used where the depth is 6 fathoms or more at low water.

A *head* is a comparatively high promontory, with either a cliffy or steep face, whereas a *point* is a comparatively low and sharp promontory. The word *cape* should be restricted to promontories facing the open water.

Mountains, hills, and knolls are comparative terms of heights varying with the general configuration of the country, but *peaks* are essentially hills or mountains whose summits are comparatively sharp.

Coast is the term used with reference to the land, whilst the term *shore* is used with reference to the sea; for instance, the west *coast* of India forms the eastern *shores* of the Arabian sea.

The title of the fair chart.—No abbreviations, except as shown below, are to be used in the title of the fair chart. The styles of lettering of the name of the sheet may be as convenient; the remainder of the title is to contain the following information and printed according to the following lettering (*see* Plate No. 9 for explanation of lettering):—

Surveyed by, &c.	Roman Black.
Assisted by, &c.	Print.
H.M. Surveying Ship	Egyptian Capitals.
Date	Block Numerals.
Geographical Position	Print.
Magnetic Variation	Print.
Line Indicating Heights	Stump.
Soundings in fathoms or feet	Egyptian Capitals.

Under the above:—

The Tabular Form of "Tidal Informa- tion"	} See Page 66. Print.
Natural Scale	
List of Conspicuous Objects	Roman Clarendon and Clarendon Print.

The memoir.—A memoir is to appear on the fair chart in stump, and can be shown in the most convenient place. It is to contain the following information:—

- (1) The method of the construction of the chart.
- (2) References to the triangulation sheet and returns of latitude and meridian distances which affect the sheet.
- (3) All calculated latitudes and longitudes, with the longitude of the meridian on which the longitudes depend.
- (4) The longest calculated side in feet with its mercatorial bearing and half the convergency.
- (5) The two positions on which the sheet has been graduated. These should be from those given in (3) and not arbitrary calculated points.
- (6) Whether the contours of the land have been sketched in from the ground or from the ship, and if from other sources the authority in full detail.
- (7) Any additional remarks considered necessary, such as general quality of the bottom, general remarks as to tidal streams or tides, should they be too long to appear in the title or on the work itself.

Triangulation sheet.—A separate sheet called the triangulation sheet is to be forwarded with the fair chart of every survey. No special system of drawing need be followed, but if any special

symbols or colours are used a full explanation as to what they indicate is to be given. A rough plot of the coastline and triangulation on a suitable scale is to be given, the main stations lettered in capitals and other stations in small letters. In addition, the following information is to be given:—

- (1) The angles of each triangle, differentiating between those observed and those calculated, together with the lengths of the sides in feet.
- (2) A list of true bearings, stating definitely how such bearings were obtained, *i.e.*, by direct observation, calculated through the triangulation or from astronomical positions, or obtained from any other sources such as ordnance survey.
- (3) The length in feet and the mercatorial bearing and half-convergency of the long side of the triangulation which has been used.
- (4) The base on which the survey depends, and whether astronomical or measured.
- (5) A description of the stations, with their distinguishing letters, such descriptions to be in detail so as to ensure the stations being located at a future date. In some cases, such as mangrove shores, it is recognised that no recovery of a station can be thought of; but every detailed triangulation is, if possible, to contain two or more stations which are recoverable. As flagstaffs, beacons, &c., are liable to be moved, the bearing and distance from some permanent object shown on the chart is to be given when using them as stations.
- (6) A table giving the latitudes and longitudes of the various stations on the chart, as calculated in the triangulation or as observed, clearly stating how derived, *e.g.*, latitude by stars, longitude by telegraphic determination, or supplied from local surveys.
- (7) A summary containing the latitudes and longitudes of various points as accepted by the surveyor, the accepted true bearings, the number of feet per cent. which has to be added or subtracted from the sides as obtained trigonometrically, or if triangulation has been accepted the amounts which have been applied to the latitudes, longitudes, and true bearings to bring all into agreement, together with a précis of the reasons for arriving at these decisions.
- (8) A table giving the exact positions of the observation spots, and bearings or angles and distances to well-defined objects, so that the spot may be recovered at a future date, even if its position is lost.

Size of triangulation sheets.—Triangulation sheets are to be forwarded on uniform-sized sheets, *viz.*, half double elephant, 25 × 18, and if necessary more than one scheme may be included on one sheet,

provided that the areas triangulated are in relatively close proximity.

Paper to be used for triangulation sheets.—Mounted paper is invariably to be used.

The plotting sheet is to be most carefully handled, so as to prevent distortion, and must either be kept flat or rolled. It is not required in the Hydrographic Department, so that on acknowledgment of the receipt of the fair chart and triangulation sheet it can be destroyed if no longer likely to be required.

Ordnance data.—When an Ordnance triangulation is used in home surveys, or an authoritative one is used abroad, the construction of a triangulation sheet may be dispensed with, but the document forwarded must answer all the information required above. Ordnance survey data, as supplied to H.M. surveying ships on home surveys, generally consist of the following documents:—

- (1) A tabulated list of named trigonometrical stations, with their co-ordinates, from a named point of origin.
- (2) The accurate latitude and longitude of the point of origin, and sometimes also of one of the trigonometrical stations given in the list of co-ordinates.
- (3) The azimuths of one or more of the sides of the triangulation from which the co-ordinates are derived.
- (4) A series of "Descriptions of Stations," by which the actual positions of the mark-stones of the trigonometrical stations given may sometimes be recovered.
- (5) A tracing on a convenient scale forming a key to the whole system of triangulation, giving the relative positions and names of the trigonometrical stations, with the sides employed, and (usually) the lengths in feet of each of them.
- (6) A tabulation of the angles of each triangle, with the lengths of its sides in feet, is sometimes supplied; but is of little use for hydrographic work except as affording an occasional check on calculations.

When the data given cover a large area, and consist, as often occurs, of information regarding over 100 or 200 triangles, it is essential to index in some convenient and thorough manner, or considerable time and labour will be occupied later in attempts to obtain some particular item among so much information.

The following method of indexing is to be adopted:—

- a. In Document 1 give consecutive numbers in red ink to each station tabulated in the List of Co-ordinates.
- b. Stitch together the pages of the "Descriptions of Stations" in book form, and number each page consecutively (Document 4).
- c. Make a list of all the names of the trigonometrical stations in alphabetical order, being careful to spell the names exactly as

given in Documents 1 and 4, and place abreast of each name so as to form an Index its allotted number as a Co-ordinate (Document 1) and its page in the Descriptions (Document 4).

NOTE.—It will be found that there are not infrequently two or more stations in the same triangulation that have been given either exactly the same name, or names that differ but slightly from one another, and care must be exercised in dealing with them.

They can usually be differentiated by their co-ordinates, assisted by the key-tracing of the triangulation.

- d. The key-tracing (Document 5) should next be dealt with, and both the "Co-ordinate number" and the "Description number" from the Index written abreast of each named position on it, the former in red ink, the other in black for identification.
- e. Lastly, the 6-inch Ordnance maps supplied should be joined together to form a single sheet (or sheets of convenient size), and the position of each trigonometrical station shown on them accentuated in red ink, with the name allotted in the List of Co-ordinates written abreast of it, with both its Index references.

With the 6-inch maps laid out, and marked as above indicated, the main triangulation of the hydrographic survey contemplated can now readily be planned; and by the above system of indexing the required data quickly turned up. Any omissions in the data can also be seen at once, and application made for additional information required.

Lettering of triangulations.—Great care is to be taken in lettering stations that the same letter is given to the same station of an overlapping triangulation, and also that the lettering corresponds to that on the fair chart forwarded.

Cloth or paper tracings.—The remarks as to draughtsmanship under the fair chart apply equally, where applicable, to tracings of any description that are forwarded to the Hydrographic Department. The tracings used in the course of the survey are those made for transferring details accurately to the fair chart, and these are to be of moderate size, so as to avoid distortion as far as possible, and thus the details may be transferred easily by means of a tracer and transfer paper prepared with black lead or red or blue chalk, the two latter being preferable as being less dirty.

If a tracing be used for transferring points or work from one sheet to another, tracing paper is to be used instead of tracing cloth, every care being taken to eliminate any possible errors due to distortion.

A cloth tracing is to be used for collecting the work done in the course of the survey; this is known as the collector tracing, and the points are to be pricked through from the plotting sheet. The work of the survey is to be transferred to this collector from time

to time, and it thus constitutes a record of what has been done, and is for that reason most valuable to the survey. It must not, however, be used for transferring points to boards, &c., as it is very liable to distortion. It is to be retained in the ship till acknowledgment of the receipt of the fair chart at the Hydrographic Department, when it is to be sent to that Department, unless actually required for use in the ship, in which case it is to be forwarded as soon as possible after it is finished with. Before the fair chart is forwarded it must be carefully checked with the collector to see that the latter agrees in every respect.

A collector on mounted paper can be used if preferred, and although entailing a little extra work and care its utility is considerably greater than one on tracing cloth.

Tracings forwarded to the Hydrographic Department are always to be paper tracings excepting in cases where distortion is immaterial, *e.g.*, the tracing showing work completed which is forwarded in the "Annual Report of Survey" may be rendered on tracing cloth with advantage. All tracings are to be of moderate size, not larger than about 25 inches \times 18 inches.

Views.—Views are to be forwarded on mounted paper, the size of such never being less than 12 inches \times 8 inches. They are to be shown by etching in Indian ink, or painted in either Indian ink, sepia, Payne's grey or neutral tint as preferred, writing indicating leading marks, hills, or other special features being in red.

Photographs, when forwarded, are to be pasted on mounted paper not less than 12 inches \times 8 inches, and if small two or more may be included on one sheet; the remarks in "Views," as to writing, &c., is also to be followed in photographs. No writing of any description is to appear on the photograph, necessary remarks being written on the mount surrounding it.

General.—All work sent to the Hydrographic Department which deals with a chart or corrections thereto is to be surrounded by a framework or graduation as the case may be, and the name of the Surveyor who draughted the work is invariably to be given at the bottom left-hand corner *inside* the outer margin, the signature and approval of the Officer in charge of the Survey being given in a convenient place on the body of the work—no work, writing, or remarks of any description whatever are to appear outside this framework. These instructions apply also to all tracings, fair charts, triangulation sheets, views, or photographs which may be forwarded.

SECTION V.

SAILING DIRECTIONS.

1. Though a good chart is the primary guide to a navigator, there is a large amount of matter necessary for his information that cannot be contained in it, and no survey is complete unless accompanied by full sailing directions. Notes for these should be continually accumulating during the course of the survey, and the directions themselves must be compiled immediately after the conclusion of the work in the field, when every essential point is fresh in the memory, being eventually forwarded with the fair chart.

It is impossible to write from notes, at a distance of time, so accurately or graphically as when those notes are assisted by a fresh recollection of events and places.

2. Sailing directions should not contain matter which can be easily gathered from the study of the chart. Thus, as a general rule, bearings and distances *from one small point to another* should not be given, as they distract attention from more important facts; but the general direction or trend of the coast must be recorded, and where there is anchorage, the bearings and distances of the points of a bay, or of islands in it, are useful.

3. Courses and bearings are invariably to be given as TRUE and in degrees, measured clockwise from 0° (North) to 360°, in accordance with the system now introduced into all hydrographic publications.

4. Care must be taken in writing sailing directions for incorporation into an existing book, to follow the same geographical sequence as is pursued in the book itself, *i.e.*, to work from east to west, or from north to south, as may be already adopted in the book.

5. In writing sailing directions that will partly add to and partly supersede those already published, the whole of the part of the book is to be re-written, retaining those paragraphs that hold good, and interpolating the fresh matter.

6. It is not possible to lay down invariable rules as to the order in which the different remarks comprised in sailing directions should be dealt with, but the following rules are, so far as is possible, to be observed:—

- a. General remarks, stating the order that will be pursued in treating the subject, with a general description of the district, divided into sections; geographical, geological, hydrographical, and meteorological. A good summary of the last subject is

especially useful, and should comprise the prevailing winds and currents and their seasons; land and sea breezes, when they exist: weather: rainy seasons; prevalence of fogs; range of temperature and barometric readings.

- b.* Description in detail of the shores and dangers should then follow, including in each chapter a conveniently large portion of the coast, say, from one prominent headland to another, or a certain group of islands, completing each section before commencing another.

- c.* Lastly, should come the sailing directions for each portion of coast, passage, or harbour, after all the places and objects have been separately described. In like manner, any general sailing directions for making passages over long distances should be dealt with separately.

- d.* In large channels, after a general description, the details are to be confined to one reach at a time, each shore being described separately, and worked down in the same direction, which should be that followed by a vessel arriving from seaward, and from Europe, as far as may be possible.

7. In describing a portion of coast some such order as the following must be observed:—

- a.* The appearance or aspect of the coast on making the land, describing prominent objects, as, on a bold coast, the headlands, peaks, &c., with their form, colour, and height; or, on a flat coast, the conspicuous buildings, beacons, &c.
- b.* Description of the outlying dangers and islands, and off-shore soundings, with nature of bottom.
- c.* Directions for clearing the off-lying dangers, if such are at a sufficient distance from the land to form conveniently a separate paragraph of directions.
- d.* Information as to pilots; their cruising ground; any special regulations or signals; their charges; the possibility of obtaining tugs, &c.
- e.* In case of stress of weather, the best anchorage or the nearest harbour of refuge to run for; or, in extreme cases of leak, &c., the best place to lay the ship aground.
- f.* A description of the shore, with the character of the inshore dangers, headlands, points, bays, anchorages, islands, rivers, &c., and especially lights, buoys, and beacons. The amount of detail to be given in this description will, of necessity, vary with the nature of the coast and other considerations.
- g.* Harbours and anchorages require the closest description, and it is always to be clearly stated whether they afford good, fair, or indifferent shelter; whether the holding ground is good or bad,

and the quality of the bottom; whether anchorage can be taken up for long or short periods; and whether it is suitable for a number of vessels in company or for single vessels only.

If any particular natural conditions, such as squalls, sudden shifts of wind, sudden changes of stream, &c., tend to make an anchorage inconvenient or unsafe, it is to be stated whether such conditions can be forecasted by observation of such local peculiarities as excessive humidity or dryness, high peaks becoming obscured by cloud, unusual swell or motion of the water, remarkable clearness of the atmosphere, &c.

- h. Currents, tides, and tidal streams are to be grouped together in separate paragraphs; rise and range of tide must both be given where known; also the time of the turn of the tidal stream with reference to the time of high water and its duration.

The tidal streams in the neighbourhood of standard ports of reference given in the tide tables are to be referred to these ports; elsewhere to the local mean time of high water.

All references to be given as before or after high water and never to low water. The term "flood" and "ebb" stream are never to be used, excepting in a port, and only then when the turn of the stream is within an hour of high water or low water; the TRUE direction, measured clockwise in degrees from 0° (North) to 360°, being used instead of flood and ebb.

8. The detailed information, under "f," should comprise the following:—

Lifeboat and life-saving stations.

Dangers: Their extent and nature; the depth over them at low water springs; whether visible; if breaking, at what period of tide; whether any part dries, and how much. Whenever banks or rocks dry, information concerning them is to take the form of stating the number of feet they dry at low water springs, or as "dries so many feet."

The term "awash" is only to be used when the danger is awash at low water springs. When it is awash at any other state of tide it is to be given as "dries so many feet."

Marks for clearing them by day or by night. The bearings of leading marks and clearing marks are to be given as TRUE and in degrees, and for such clearing marks it must be stated that, for instance, the mark leads eastward or westward of the danger, and not clears to the eastward or westward.

Bars: The best time for crossing; bar signals.

Character of points; cliffy, wooded, sandy, &c. Height and appearance of elevations. Distinguish between mountains and hills. As a general rule, except in a very mountainous country,

all may be considered as mountains over 1,000 feet in height. In all cases state the height if possible, giving an estimated one where it has not been measured. Mention whether summits are usually clouded or not, and whether snow lies on them, and if so, at what seasons. When the height given is that of the tops of the trees it must be so stated.

Islands; size, height, whether wooded, cultivated, bare, &c.

9. Quality of the bottom. — Under special circumstances, where it is considered necessary to amplify the information already given on the fair chart beyond those of anchorages, a description of the quality of the bottom is to be given with the fullest details possible, such as a layer of mud over sand, sand or mud over the remains of wrecks, &c.

Landing places, especially when the coast is open or exposed to swell.

Rivers: When rivers of any importance are mentioned, give, if possible, their source, elevation, length, general course, points to which the tide flows, and to which they are navigable both by ship and by boats. Strength of stream before and after rains.

In all Sailing Directions describing tidal harbours, rivers, or ports, a separate paragraph is to be inserted stating the *least depth* of water a vessel must pass over, both at low water and high water, in order to reach her destination, also the distance of the latter from the sea and the position of the bar or shallow water referred to.

In the case of large rivers, a table giving distances from bar or outer light or buoy, least depth to be passed at low water springs, rise of tide at springs and neaps, and rate and time of turn of tidal streams at various places on the river will be useful.

Streams; size; whether fit for watering, and if fit for drinking or only for boiler use.

Lights and lighthouses claim particular attention. Every detail that can be useful to the mariner must be obtained, character, visibility, arcs of visibility and obscuration, limits of coloured sectors, &c. The appearance, position, and colour of the lighthouse, its height, and when a lighthouse is placed high information must be given as to whether it is specially liable to be obscured by clouds or mist; the height of the light above high water, description and position of lighthouse buildings, fog signal stations, signal stations, and means of communication with nearest village, port, &c. The appearance and number of masts and daymarks of light-vessels with their means of mooring, the height of the light, character and visibility; the degree of trust that can be placed in the maintenance of their positions. If

additional lights are needed it should be so stated, suitable positions being named.

Photographs or sketches of lighthouses are especially valuable if taken from seaward.

10. Sailing directions for a harbour, written for a vessel entering only, will often be sufficient, but in certain cases it is desirable that directions should also be given for leaving a port.

11. In describing seaports, give so much of general statistics as will enable a stranger to judge of their importance, probable abundance of supplies; *see* above, on description of tidal harbours, &c.

- a. Draught of the largest ship that can enter in case of tidal or shallow harbours at low and high tides, and depths alongside any piers.
- b. Facility for, and manner of, coaling, with nature of shelter afforded by the harbour or anchorage. Number of lighters available. Depth alongside coaling wharf and all piers at low water; or, still better, what is the draught of vessels which can lie alongside at low water springs. Similar information respecting the supply of liquid fuel to ships is also to be given.
- c. How coals and liquid fuels are obtained; from a near or distant locality. Whether wood for fuel can be procured in quantity sufficient for steaming purposes or to combine with coal. A great deal of information relative to coaling places having been already collected, care is to be taken that the Admiralty book of sources of supply of coal, provisions, &c., is consulted before furnishing further information.
- d. Number of ships belonging to the port. Number of arrivals and sailings annually, both in ballast and cargo.
- e. Chief exports and imports. Any special port regulations, bye-laws and Custom-house regulations; holidays, &c.
- f. Dock accommodation, both wet and dry, with full particulars. Patent slip. Gridiron.
- g. Facilities for repairs to a vessel and to her machinery. Power of largest crane or sheers, and particulars of machinery for repairs of engines.
- h. Quarantine regulations. Hospital or home for sailors, number of beds. Shipping office for seamen.
- i. Prevailing diseases, if of a virulent character (as on the coast of Africa); seasons at which they may be expected, and brief precautions for guarding against them, diet, clothing, &c.
- j. National prejudices in cases where serious offence may be given unintentionally.
- k. Population; number of fishermen and seafaring men.

1. British representatives.

- m. Means of communication by steamers, rail, electric and wireless telegraphy, &c.
- n. History and antiquities only to be very briefly touched upon; a reference to be made to works in which further information may be found; political facts may be briefly stated, but all political opinions are to be avoided.
- o. Time signals, harbour signals, fog signals, and storm warnings, when established, are to be noted and described.

12. The following shading is to be used to indicate colours of flags and beacons where necessary:—



Yellow.



Red.



Blue.



Green.



Black.

13. Throughout observe uniformity in the various terms used in expressing capacity, distance, height, and length, respectively. Heights are to be given in feet above the level of high water springs; depths in fathoms or feet below low water ordinary springs. The height in feet above mean low water springs is to be given for banks or rocks that dry at certain times of tide. Distances, when less than a mile, are to be given in cables or yards; when parts of a mile or of a cable are mentioned, they are to be as vulgar fractions, not as decimals, which may lead to error.

14. The expression "*shoal*" should be limited to a detached area, the depths over which constitute a danger. A detached area, the depths on which do not constitute a danger, should be called a *bank*. A shoal area connected to the shore is not properly a shoal, but rather a spit, sand, or bank.

Shoals and banks may be of any material.

A "*reef*" is an area of rocks, or coral, detached or otherwise, of considerable extent, which dries, or nearly does so, in places.

15. When referring to the edge of the land it is to be called *coast*, when to the border of water it must be termed *shore*. Thus, the *coast* of England, but the *shore* of the North sea.

16. Names require much care. In all cases when the native name is obtainable it is alone to be used, except when a European name has been attached so long to a place that it is recognised generally, in which case both may be given.

17. In spelling the names of places in any language which is either unwritten or written in other characters than the Roman, the system laid down by Admiral Washington is to be closely adhered to. This system is reprinted on pages 82 to 84.

The apostrophe "s" is not to be used for any new names, but it can be retained in names of old standing when universally adopted, for instance, St. George's channel, St. Anne's head.

17. System of orthography.—

- (1) The method adopted by the Admiralty for spelling names, given on the following pages, is to be closely followed, and the surveyor must always be on the lookout in all parts of the world to correct the numerous instances in which names appear on the charts that are manifestly not in accordance with this method, but which cannot be altered until the proper sound of the word as ascertained on the spot is rendered according to the rules.
- (2) The system adopted and described herein, originally introduced by Admiral Washington, has been accepted by the Royal Geographical Society, and all public departments in Great Britain, as well as by the United States.

As far as has been found possible with existing knowledge, native names are spelt in accordance with this system, which has been for some years in process of gradual introduction into all Admiralty Sailing Directions and Charts.

No change is made in the orthography of foreign names in countries which use Roman letters; thus French, Spanish, Portuguese, Dutch, &c., names will be spelt as by the respective nations.

- (3) Where native names have been so long written in a form which, though not in accordance with this system, has become familiar to English eyes, from being so spelt in all charts and maps, they are retained.
- (4) The true sound of the word, as locally pronounced, is taken as the basis of the spelling.
- (5) An approximation of the sound is alone aimed at. A system which would attempt to represent the more delicate inflections of sound and accent, would be so complicated as only to defeat itself.
- (6) The broad features of the system adopted are that vowels are pronounced as in Italian and consonants as in English; *every letter being pronounced*. Two accents only are used:—
 - (a) The acute, to denote the syllable on which stress is laid. The use of this is very important, as the sounds of many names are entirely altered by the misplacement of this "stress."
 - (b) The sign " over the letter *u* to denote the short sound of that vowel under certain circumstances. (See Table.)
- (7) When two vowels come together, each one is sounded, though the result, when spoken quickly, is sometimes scarcely to be distinguished from a single sound, as in *ai, au, ei*.

The amplification of the rules is as follows:—

Information is invited as to the proper spelling of native names, so as to produce the nearest approximation to the true sound, by this system.

Letters.	Pronunciation and Remarks.	Examples.
a	<i>ah</i> , <i>a</i> as in <i>father</i> - - - - -	Java, Banána, Somáli, Bari.
e	<i>eh</i> , <i>e</i> as in <i>bet</i> ; <i>a</i> as in <i>fate</i> - - -	Tel-el-Kebír, Oléleh, Yezo, Levúka, Peru.
i	English <i>e</i> ; <i>i</i> as in <i>ravine</i> ; the sound of <i>ee</i> in <i>beet</i> . Thus, not <i>Feejee</i> , but	Fiji, Hindi.
o	<i>o</i> as in <i>mote</i> - - - - -	Tokyo.
u	long <i>u</i> as in <i>flute</i> ; the sound of <i>oo</i> in <i>boot</i> . <i>oo</i> or <i>ou</i> should never be employed for this sound. Thus, not <i>Zooloo</i> or <i>Zoulou</i> , but The shorter sound of the different vowels, when necessary to be indicated, can be expressed by doubling the consonant that follows. The sounds referred to are as follows:— The short <i>a</i> as in <i>fatter</i> , as compared with the long <i>a</i> as in <i>father</i> . The short <i>e</i> as in <i>better</i> , as compared with the long <i>e</i> as in <i>fate</i> . The short <i>i</i> as in <i>sinner</i> , as compared with the long <i>i</i> as in <i>ravine</i> . The short <i>o</i> as in <i>sobbing</i> , as compared with the long <i>o</i> as in <i>sober</i> . The short <i>u</i> as in <i>rubber</i> , as compared with the long <i>u</i> as in <i>rubric</i> .	Zulu, Sumatra. Yarra, Tanna, Mecca, Jidda, Bonny.*
ü	is the same short sound of <i>u</i> as is denoted by doubling the consonant following, but is used, and only used, where such doubling is impossible, as in the case of words where <i>u</i> is followed by two different consonants, as in <i>Tung</i> , pronounced as the English <i>tongue</i> . Doubling of a vowel is only necessary where there is a distinct repetition of the single sound.	Nuulúá, Oosima.
ai	English <i>i</i> as in <i>ice</i> - - - - -	Shanghai.
au	<i>ow</i> as in <i>how</i> . Thus, not <i>Foochow</i> , but	Fuchau.
ao	is slightly different from <i>au</i> - - -	Macao.
aw	when followed by a consonant or at the end of a word, as in <i>law</i> - - - thus	Cawnpore.
ei	is the sound of the two Italian vowels, but is frequently slurred over, when it is scarcely to be distinguished from <i>ey</i> in the English <i>they</i> , or <i>ei</i> in <i>eight</i> .	Beirút, Beilul.

* The *y* is retained as a terminal in this word under Rule 3 (page 81). The word is given as a familiar example of the alteration in sound caused by the second consonant.

Letters.	Pronunciation and Remarks.	Examples.
b	English <i>b</i> .	
c	is always soft, but is so nearly the sound of <i>s</i> that it should be seldom used. If <i>Celêbes</i> were not already recognised it would be written <i>Selêbes</i> .	Celêbes.
ch	is always soft, as in <i>church</i> - - -	Chingchin.
d	English <i>d</i> .	
f	English <i>f</i> . <i>Ph</i> should not be used for the sound of <i>f</i> . Thus, not <i>Haiphong</i> , but	
g	is always hard. (Soft <i>g</i> is given by <i>j</i>) -	Haifong, Nafa.
h	is always pronounced when used.	Galâpagos.
hw	as in <i>what</i> ; better rendered by <i>hw</i> than <i>wh</i> , or <i>h</i> followed by a vowel. Thus, <i>Huang</i> <i>ho</i> , not <i>Whang ho</i> or <i>Hoang ho</i> .	Hwang ho, Ngon hwei.
j	English <i>j</i> . <i>Dj</i> should never be put for this sound.	Japan, Jinchuen.
k	English <i>k</i> . It should always be put for the hard <i>c</i> . Thus, not <i>Corea</i> , but	Korea.
kh	The Oriental guttural - - -	Khan.
gh	is another guttural, as in the Turkish -	Dagb, Ghazi.
l	} As in English.	
m		
n		
ng		
	has two separate sounds, the one hard as in the English word <i>finger</i> , the other as in <i>singer</i> . As these two sounds are rarely employed in the same locality, no attempt is made to distinguish between them.	
p	As in English.	
ph	As in <i>loophole</i> - - - - -	Mokpho, Chemulpho.
th	stands both for its sound in <i>thing</i> , and as in <i>this</i> . The former is most common -	Bethlehem.
q	should never be employed; the sound of <i>qu</i> in <i>quiver</i> is given as <i>kw</i> . When <i>qu</i> has the sound of <i>k</i> , as in <i>quoit</i> , it should be given by <i>k</i> .	Kwangtung.
r	As in English.	
s	As in <i>sin</i> .	
sh	} As in English.	
t		
v		
w		Sawâkin.
x	- - - - -	
y	is always a consonant, as in <i>yard</i> , and therefore should never be used as a terminal, <i>i</i> or <i>e</i> being substituted. Thus, not <i>Mikindiny</i> or <i>Wady</i> , but not <i>Kwaly</i> , but	Kikûyu.
z	English <i>z</i> - - - - -	Mikindani, Wadi. Kwale. Zulu.

Letters.	Pronunciation and Remarks.	Examples.
zh	French <i>ʃ</i> , or as <i>s</i> in <i>treasure</i> - - - Accents should not generally be used, but where there is a very decided emphatic syllable or stress which affects the sound of the word, it should be marked by an <i>acute</i> accent.	Muzhdaha. Tongatābu, Galāpagos, Palāwan, Sarāwak.

In the case of native names in countries under the dominion of other European powers, in whose maps, charts, &c., the spelling is given according to the system adopted by that power, such orthography is, as a rule, disregarded, and the names are spelt according to the British system. Thus the island east of Java in possession of the Dutch is spelt Madoera by them, but on Admiralty charts Madura. A town in Java appears on Dutch charts as Tjilatjap; in the British, Chilachap.

When a foreign language is written in a vocabulary of fixed sounds, so as to permit of transliteration into the British system, a table of equivalents for each letter is drawn up, and names of places can be transliterated without regard to pronunciation.

It is rarely, however, that any language is absolutely without variation in the sound of any letters or combination of letters. This system therefore requires care. The rules for such transliterations so far adopted by the Admiralty are here given.

To reduce Greek names to the orthographic form, required by the foregoing system, would require so many changes that it has been decided to defer the revision of Admiralty publications until the system has been more generally introduced and used.

The Greek names are therefore left for the present in their old shape, but these give in most cases a very erroneous idea of the sound of the names, as pronounced by Greeks, and in many cases the present spelling gives a clue to the pronunciation by aid of the table of equivalents.

Thus *Ευβοία* now spelt Eubœa is pronounced Evvia.
 „ *Χαλκίς* „ Chalcis „ Khalkis.
 „ *Κεφαλληνία* „ Cephallonia „ Kefallinia.

Whenever C appears in a Greek name as at present written it may be taken for granted it has the sound of K.

Greek Letters	Roman Equivalents by System	Greek Letters	Roman Equivalents by System
A α	a	P ρ	r
B β	v	Σ σ s	s
Γ γ	g	T τ	t
Δ δ	d	Υ υ	i
E ε	e	Φ φ	ph
Z ζ	z	X χ	kh
H η	i	Ψ ψ	ps
Θ θ	th	Ω ω	o
I ι	i	ΑΙ αι	ei
K κ	k	ΕΙ ει	i
Λ λ	l	ΟΙ οι	i
M μ	m	ΟΥ ου	u
N ν	n	Υι υι	i
Ξ ξ	x	ΑΥ αυ	aph, av
Ο ο	o	ΕΥ ευ	eph, ev
Π π	p	ΗΥ ηυ	iph, iv

In the transliteration of names in India and the Persian Gulf, the rules adopted by the Indian Government have been adopted, excepting that where the letter Q not followed by "u" is used in that system, the letter K is substituted.

The system is as follows:—

Letter	Initial	Medial	Final	English Equivalent
α	α	α	α	a
β	β	β	β	b
γ	γ	γ	γ	p
δ	δ	δ	δ	t
ε	ε	ε	ε	s Persian, th Arabic
ζ	ζ	ζ	ζ	j
η	η	η	η	ch
θ	θ	θ	θ	h
ι	ι	ι	ι	kh
κ	κ	κ	κ	d
λ	λ	λ	λ	z Persian, dh Arabic
μ	μ	μ	μ	r
ν	ν	ν	ν	z

Letter	Initial	Medial	Final	English Equivalent
ژ	ژ	ژ	ژ	zh
س	س	س	س	s
ش	ش	ش	ش	sh
ص	ص	ص	ص	s
ض	ض	ض	ض	z Persian, dh Arabic
ط	ط	ط	ط	t
ظ	ظ	ظ	ظ	z Persian, dh Arabic
ع	ع	ع	ع	an apostrophe
غ	غ	غ	غ	gh
ف	ف	ف	ف	f
ق	ق	ق	ق	q, but when not followed by u, k
ك	ك	ك	ك	k
گ	گ	گ	گ	g
ل	ل	ل	ل	l
م	م	م	م	m
ن	ن	ن	ن	n
و	و	و	و	v Persian, w Arabic
ه	ه	ه	ه	h
ت	ت	ت	ت	t
ی	ی	ی	ی	y

REMARKS.

Vowels. — *Fatha*, practically always *a*.

— *Kesra* is *i*.

— *Dhamma* is *u* or *o* according to pronunciation.

ل becomes *ā*.

ی " *ī*.

و " *ū*.

— *Tashdid*, placed over any consonant doubles that consonant.

Hemzuted vowels, i.e. [ٓ]ا, [ٓ]ا, [ٓ]ي, [ٓ]و, are generally transliterated with an apostrophe and the appropriate vowel, thus: 'a, 'i, 'o, 'u; but in all cases the vowel above or below the *hemzeh* ٓ is to be transliterated, and not the consonant with which it is combined.

In the transliteration of Malay or other native names from Dutch charts where they are spelt according to Dutch orthography—

Dj	has been rendered by J,
Tj	„ „ „ Ch,
oe	} „ „ „ U,
oo	
ou	
ee	„ „ „ E.

J in the middle of a word if followed by oe has been rendered by Y though not always. Ij has been rendered by ai generally.

For Chinese names, the Wade system of spelling, as modified in Playfair's "Cities and Towns of China," is adopted as a basis, being transliterated into this system in the following manner—

For CH', K', T', TS', TZ, write

CH, K, T, TS, and TZ.

For Chieh write Chie.

„ Ê, if pronounced short as in CHÊN, FÊN, &c., write Û, or U followed by a double consonant.

For Ê terminal, as in CHÊ, LÊ, &c., write AW.

For Eh write E.

„ ÊI write EI.

„ ÊRH write URR.

„ HUA write HWA.

„ HUI write HWEI.

For HUO write HWAW.

„ J write ZH.

„ KUA write KWA.

„ K'UA write KWA.

„ KUEI write KWEI.

„ K'UEI write KWEI.

„ KUO write KWAW

„ O write AW.

„ OU write O.

„ P' write PH.

„ SSÛ write SE.

„ Û write U.

„ Ü write E.

In this system the Manchurian dialect is adopted as the basis ; but with regard to names in the provinces of FU KIEN, KWANG TUNG and KWANGSI, the local pronunciation should be followed as a guide for the spelling. CHIH and SHIH, pronounced somewhat as the shi in shirt, have been retained, as the sounds are difficult to express according to the Royal Geographical Society's rules. Canton and Peiho are to be spelt in this, the customary way.

The following table gives the equivalents used by the Admiralty in the transliteration of Russian names:—

Printed Characters	Italic Characters	Equivalents in Ad ^l System	Remarks	Printed Characters	Italic Characters	Equivalents in Ad ^l System	Remarks
А а	<i>А а</i>	<i>a</i>		Т т	<i>Т т</i>	<i>t</i>	
Б б	<i>Б б</i>	<i>b</i>		У у	<i>У у</i>	<i>u</i>	
В в	<i>В в</i>	<i>v</i>		Ф ф	<i>Ф ф</i>	<i>f</i>	
Г г	<i>Г г</i>	<i>g(h)</i>	<i>If g always hard If h as in English</i>	Х х	<i>Х х</i>	<i>kh</i>	
Д д	<i>Д д</i>	<i>d</i>		Ц ц	<i>Ц ц</i>	<i>tz</i>	
Е е	<i>Е е</i>	<i>e(ye)</i>	<i>e in bet (ye when initial) Sound of French j or z in action.</i>	Ч ч	<i>Ч ч</i>	<i>ch</i>	
Ж ж	<i>Ж ж</i>	<i>zh</i>		Ш ш	<i>Ш ш</i>	<i>sh</i>	
З з	<i>З з</i>	<i>z</i>		Щ щ	<i>Щ щ</i>	<i>shch</i>	<i>shch in Russian church</i>
И и	<i>И и</i>	<i>i</i>		Ъ ъ	<i>Ъ ъ</i>	<i>mute</i>	<i>Omit transliteration in middle of a word as end . . .</i>
І і	<i>І і</i>	<i>i</i>		Ы ы	<i>Ы ы</i>	<i>{i}</i>	
К к	<i>К к</i>	<i>k</i>		Ѣ ѣ	<i>Ѣ ѣ</i>	<i>mute</i>	<i>Omit in transliteration</i>
Л л	<i>Л л</i>	<i>l</i>		Ѥ ѥ	<i>Ѥ ѥ</i>	<i>ye</i>	
М м	<i>М м</i>	<i>m</i>		Э э	<i>Э э</i>	<i>e</i>	<i>u in tale</i>
Н н	<i>Н н</i>	<i>n</i>		Ю ю	<i>Ю ю</i>	<i>yu</i>	
О о	<i>О о</i>	<i>o</i>		Я я	<i>Я я</i>	<i>ya</i>	
П п	<i>П п</i>	<i>p</i>		Ѧ ѧ	<i>Ѧ ѧ</i>	<i>f</i>	
Р р	<i>Р р</i>	<i>r</i>		Ѩ ѩ	<i>Ѩ ѩ</i>	<i>œ</i>	<i>Seldom used</i>
С с	<i>С с</i>	<i>s</i>		Ѫ ѫ	<i>Ѫ ѫ</i>	<i>i</i>	

Note. The combinations БИѢ and Ш should be transliterated i.

SECTION VI.

GEOGRAPHICAL POSITIONS.

When using values of latitudes and longitudes *in arc* in rendering returns, quoting positions, &c., should the minutes and seconds be under 10, the amount is always to be preceded by an 0. Thus:—

Latitude $17^{\circ} 08' 03''$, and not $17^{\circ} 8' 3''$.

Longitude $115^{\circ} 06' 02''$, and not $115^{\circ} 6' 2''$.

When using longitude *in time* the same rule is to be observed. Thus:

Longitude 7h. 04m. 02s., and not 7h. 4m. 2s.

In all cases it is quite sufficient to give the *arc* measurement to the nearest one-tenth of a second, and the *time* measurement to the nearest one-hundredth of a second.

TABLE OF GEOGRAPHICAL POSITIONS OF VARIOUS
OBSERVATORIES AND OTHER FIXED POINTS
ACCEPTED BY THE HYDROGRAPHIC
DEPARTMENT, 1915.

Unless otherwise stated the position given for the Observatory is that of the Transit Instrument.

EASTERN SHORES OF ATLANTIC OCEAN AND NEIGHBOURING SEAS.

Place.	Observation Spot.	Chart.	Latitude.	Longitude.	
				in Arc.	in Time.
			° ' "	° ' "	h. m. s.
Greenwich	Observatory	3337	51 28 38 N.	0 00 00	0 00 00.0
Petrograd	Pulkowo observatory	2191	59 46 19 N.	30 19 39 E.	2 01 18.6
Copenhagen	Observatory	3194	55 41 13 N.	12 34 40 E.	0 50 18.7
Christiania	Observatory	3712	59 54 44 N.	10 43 23 E.	0 42 53.5
Amsterdam	Wester kerk, west tower.	2322	52 22 30 N.	4 53 02 E.	0 19 32.1
Paris	Observatory	—	48 50 11 N.	2 20 14 E.	0 09 20.9
Lisbon	Royal Astronomical observatory, dome.	89	38 42 31 N.	9 11 10 W.	0 36 44.7
Cadiz	San Fernando observatory.	80	36 27 42 N.	6 12 20 W.	0 24 49.3
Gibraltar	Dockyard clock tower	144	30 07 16 N.	5 21 13 W.	0 21 24.9
Naples	Capo di Monte observatory.	1728	40 51 46 N.	14 15 26 E.	0 57 01.7
Malta	Old site of Spencer's monument. +	974	35 53 01 N.	14 30 39 E.	0 58 02.6
Pola	Observatory	202	44 51 49 N.	13 50 46 E.	0 55 23.1
Athens	Observatory	1513	37 58 20 N.	23 43 14 E.	1 34 52.9
Constantinople	St. Sophia, dome	1198	41 00 16 N.	28 59 04 E.	1 55 56.3
Nikolaev	Observatory	2378	46 58 21 N.	31 58 26 E.	2 07 53.7
Smyrna	Site of mill on Dara-gaz point. +	1521	38 26 30 N.	27 08 48 E.	1 48 35.2
Alexandria	Ras el tin lighthouse	3179	31 11 40 N.	29 51 37 E.	1 59 26.5
Madeira	Funchal, Fort Santiago flagstaff.	1689	32 38 04 N.	16 53 53 W.	1 07 35.5
Cape Verde islands.	St. Vincent, Porto Grande Telegraph Office flagstaff.	370	16 53 20 N.	24 59 22 W.	1 39 57.5

EASTERN SHORES OF ATLANTIC OCEAN, ETC.—continued.

Place.	Observation Spot.	Chart.	Latitude.	Longitude.	
				in Arc.	in Time.
Ascension	Cross Hill, signal station flagstaff.	1691	7 56 00 N.	14 24 17 W.	h. m. s. 0 57 37.1
Bonny	Com. Pullen's observation stone.	622	4 27 19 N.	7 10 01 E.	0 28 40.1
Sao Thomé	Anna das Chaves bay, Com. Pullen's observation stone.	386	0 20 38 N.	6 44 07 E.	0 26 56.5
St. Paul do Loanda.	Com. Pullen's observation stone.	604	8 48 39 S.	13 13 44 E.	0 52 54.9
Benguela	Telegraph office, observation spot. +	1215	12 34 43 S.	13 23 56 E.	0 53 35.7
Mossamedes	Com. Pullen's observation stone.	1197	15 11 13 S.	12 09 17 E.	0 48 37.1
Port Nolloth	Com. Pullen's observation stone.	1234	29 15 12 S.	16 52 02 E.	1 07 28.1
Cape of Good Hope.	Observatory	1920	33 56 03 S.	18 28 41 E.	1 13 54.7

WESTERN SHORES OF ATLANTIC OCEAN.

Montreal	McGill University transit pier.	2788	45 30 21 N.	73 34 40 W.	4 54 18.7
St. John's (Newfoundland).	Roman Catholic cathedral, North Tower Δ	298	47 34 00 N.	52 42 46 W.	3 30 51.1
Halifax	Dockyard flagstaff.	311	44 39 30 N.	63 35 11 W.	4 14 20.7
Boston	Cambridge observatory.	2482	42 22 53 N.	71 07 44 W.	4 44 31.0
Key West	Lighthouse	2881	24 33 01 N.	81 48 01 W.	5 27 12.3
Vera Cruz	San Juan de Ulua Fort, W. Bastion + (site of old lighthouse).	2854	19 12 30 N.	96 07 57 W.	6 24 31.8
Colon	+ Site of Manzanillo point lighthouse.	3111	9 21 55 N.	79 54 39 W.	5 19 38.6
Havana	Morro lighthouse	414	23 09 26 N.	82 21 29 W.	5 29 26.0
Santiago (Cuba)	Morro lighthouse	443	19 57 29 N.	75 52 03 W.	5 03 28.2
Kingston (Port Royal).	Fort Charles flagstaff.	456	17 55 56 N.	76 50 37 W.	5 07 22.5
San Juan de Puerto Rico.	Morro lighthouse	478	18 28 23 N.	66 07 26 W.	4 24 29.7
St. Thomas	Fort Christian, southwest angle.	2183	18 20 23 N.	64 55 52 W.	4 19 43.5
Santa Cruz (Virgin islands).	Lang's observatory	485	17 44 43 N.	64 41 17 W.	4 18 45.1
St. John (Antigua).	Cathedral, north tower	2065	17 06 14 N.	61 50 27 W.	4 07 21.8
St. Pierre (Martinique).	St. Marthe battery, observation spot. +	495	14 43 54 N.	61 11 11 W.	4 04 44.7
Bridgetown (Barbados).	Rickett's battery flagstaff.	502	13 05 42 N.	59 37 18 W.	3 58 29.2
Port of Spain (Trinidad).	Harbour Master's office (site of Water battery flagstaff).	2007	10 38 39 N.	61 30 38 W.	4 06 02.6
Para	Custom House portico	397	1 26 59 S.	48 30 01 W.	3 14 00.1
Pernambuco	Picão lighthouse	969	8 03 22 S.	34 51 57 W.	2 19 27.8
Bahia	San Antonio lighthouse	506	13 00 37 S.	38 32 06 W.	2 34 08.4
Rio de Janeiro	Fort Villegagnon, observation spot.	541	22 54 46 S.	43 09 29 W.	2 52 37.9

WESTERN SHORES OF ATLANTIC OCEAN—continued.

Place.	Observation Spot.	Chart.	Latitude.	Longitude.	
				in Arc.	in Time.
Monte Video -	Cathedral, south-east tower.	2001	34 54 33 S.	56 12 15 W.	h. m. s. 3 44 49.0
Buenos Aires -	Site of cupola of old custom house.	2526	34 36 30 S.	58 22 14 W.	3 53 29.0
Punta Arenas -	Old Boat House +	545	53 09 53 S.	70 54 03 W.	4 43 36.2
Port Famine -	Observation spot +	547	53 38 37 S.	70 56 37 W.	4 43 46.5

INDIAN OCEAN AND RED SEA.

Cape of Good Hope.	Observatory -	1920	33 56 03 S.	18 28 41 E.	1 13 54.7
Zanzibar -	Ras Shangani, Government Hospital flagstaff.	3211	6 09 46 S.	39 11 05 E.	2 36 44.3
Perim -	High lighthouse -	923	12 39 13 N.	43 25 53 E.	2 53 43.5
Aden -	Ras bin Jarbein, clock tower.	3660	12 47 19 N.	44 58 57 E.	2 59 55.8
Suez -	Port Ibrahim, South Mole Head light-house.	3214	29 56 11 N.	32 33 30 E.	2 10 14.0
Mauritius -	Port Louis, Fort George Martello tower.	713	20 08 46 S.	57 29 29 E.	3 49 57.9
Abu Shahr -	British Residency flag-staff.	27	28 59 07 N.	50 49 40 E.	3 23 18.7
Bombay -	Kolaba, G.T.S. observatory.	655	18 53 46 N.	72 48 47 E.	4 51 15.1
Madras -	Observatory -	575	13 04 03 N.	80 14 54 E.	5 20 59.6
Port Blair (Andaman islands).	Ross island B.M.C. observation spot.	514	11 40 34 N.	92 46 12 E.	6 11 04.8

JAVA, CHINA, AND JAPAN SEAS.

Penang -	Fort Cornwallis, north-east bastion flagstaff	3732	5 25 16 N.	100 20 48 E.	6 41 23.2
Malacca -	St. Paul's Hill light-house.	795	2 11 34 N.	102 15 03 E.	6 49 00.2
Singapore -	Government Offices	1995	1 17 14 N.	103 51 11 E.	6 55 24.7
Cape St. James -	Old lighthouse -	1016	10 19 33 N.	107 04 58 E.	7 08 19.9
Hongkong -	Kaulung observatory	1459	22 18 13 N.	114 10 28 E.	7 36 41.9
Amoy -	Kulangseu, signal station.	1764	24 26 46 N.	118 04 07 E.	7 52 16.5
Shanghai -	British Consulate, flagstaff.	389	31 14 41 N.	121 28 58 E.	8 05 55.9
Vladivostok -	Naval Staff Building, time ball.	1011	43 06 55 N.	131 53 28 E.	8 47 33.8
Yokohama -	French Hatoba, time ball.	3100	35 26 41 N.	139 39 03 E.	9 18 36.2
Tokyo -	Observatory -	2657	35 39 17 N.	139 44 33 E.	9 18 58.2
Manila -	Cathedral, dome	3487	14 35 31 N.	120 58 09 E.	8 03 52.6
Samboanga -	Old Spanish fort, north-west bastion.	961	6 54 04 N.	122 04 55 E.	8 08 19.7
Labuan -	Victoria harbour, Ramsay point beacon.	947	5 16 25 N.	115 16 16 E.	7 41 01.1
Batavia -	Uitkijk (old observatory time ball).	933	6 07 40 S.	106 48 40 E.	7 07 14.7
Banjuwangi -	Fort Utrecht flagstaff	3726	8 12 50 S.	114 22 59 E.	7 37 31.9
Makassar -	Fort Rotterdam, flag-staff.	2662	5 08 09 S.	119 24 20 E.	7 57 37.3
Ternate -	Resident's flagstaff -	2772	0 47 13 N.	127 22 53 E.	8 29 31.5
Amboina -	Fort Victoria, flagstaff	2611	3 41 30 S.	128 10 34 E.	8 32 42.3

NEW GUINEA, AUSTRALIA, TASMANIA, AND NEW ZEALAND.

Place.	Observation Spot.	Chart.	Latitude.	Longitude.	
				in Arc.	in Time.
Samarai (Dinner island).	Mission House, flag-staff	1088	10 30 49 S.	150 39 51 E.	10 02 39.4
Thursday island	Post office, north-east corner.	383	10 35 08 S.	142 13 17 E.	9 28 53.1
Sextant rock (Cape York).	Summit - - -	1937	10 41 44 S.	142 32 52 E.	9 30 11.5
Cooktown -	Inner end of Harbour Master's pier, observation spot+	1350	15 27 35 S.	145 15 15 E.	9 41 01.0
Townsville -	Pilot Hill, flagstaff -	1102	19 15 25 S.	146 49 58 E.	9 47 19.9
Moreton bay -	Cape Moreton, light-house.	1670a	27 01 57 S.	153 28 09 E.	10 13 52.6
Brisbane -	Observatory - -	1674	27 28 00 S.	153 01 39 E.	10 12 06.6
Sydney -	Observatory - -	1069	33 51 41 S.	151 12 26 E.	10 04 49.7
Melbourne -	Observatory - -	624	37 49 53 S.	144 58 35 E.	9 39 54.3
Hobart -	Time ball, flagstaff, site of Fort Mulgrave Δ	1054	42 53 22 S.	147 20 29 E.	9 49 21.9
Adelaide -	Observatory - -	2389	34 55 37 S.	138 35 07 E.	9 14 20.5
Albany -	Wakefield point, observation spot+	1418	35 02 00 S.	117 53 44 E.	7 51 34.9
Fremantle -	Harbour offices, time ball.	1700	32 03 15 S.	115 44 19 E.	7 42 57.3
Perth -	Observatory - -	431	31 57 10 S.	115 50 29 E.	7 43 21.9
Broome -	Lookout hill Δ	858	17 57 27 S.	122 14 19 E.	8 08 57.3
Baudin island -	Summit Δ	1716	14 07 45 S.	125 36 15 E.	8 22 25.0
Port Darwin -	Palmerston, observation spot + near telegraph office north of Fort hill.	925	12 28 10 S.	130 50 40 E.	8 43 22.7
Auckland -	Mount Victoria, flag-staff.	1970	36 49 34 S.	174 48 04 E.	11 39 12.3
Wellington -	Mount Cook Δ, initial station of New Zealand survey.	803	41 17 59 S.	174 46 41 E.	11 39 00.7

PACIFIC OCEAN AND WEST COAST OF AMERICA.

Gavutu island (Solomon Is.).	Summit, observation spot +	2058	9 06 59 S.	160 11 38 E.	10 40 40.5
Levuka (Fiji islands).	Niakombi or School house point, observation spot +	1244	17 40 45 S.	178 50 44 E.	11 55 22.9
Tongatabu -	Nukualofa, observation spot + (site of Tongan flagstaff).	1385	21 07 54 S.	175 11 49 W.	11 40 47.3
Apia (Samoa islands).	Matauta point, Pilot station, flagstaff.	2211	13 49 02 S.	171 45 36 W.	11 27 02.4
Tahiti -	Point Venus, light-house.	1158	17 29 45 S.	149 29 13 W.	9 57 50.9
Honolulu -	Clock tower -	1378	21 18 39 N.	157 52 02 W.	10 31 28.1
Esquimalt -	Duntize head, flagstaff	572	48 25 54 N.	123 26 16 W.	8 13 45.1
San Francisco -	Fort point, lighthouse	591	37 48 39 N.	122 28 36 W.	8 09 54.4
Libertad -	Inner end of pier, observation spot +	868	13 28 49 N.	89 19 20 W.	5 57 17.3
Panama -	Cathedral, south tower	1544	8 57 13 N.	79 32 10 W.	5 18 09.1
Payta -	Cathedral, west tower	1813	5 05 02 S.	81 07 16 W.	5 24 29.1
Lima -	Cathedral, south tower	1853	12 03 06 S.	77 02 38 W.	5 08 10.5
Callao -	San Lorenzo island, old lighthouse.	1853	12 04 05 S.	77 15 43 W.	5 09 02.9

PACIFIC OCEAN AND WEST COAST OF AMERICA.—*continued.*

Place.	Observation Spot.	Chart.	Latitude.	Longitude.	
				in Arc.	in Time.
			° ' "	° ' "	h. m. s.
Arica -	Iglesia Matrix, spire -	1340	18 28 43 S.	70 19 59 W.	4 41 19.9
Caldera -	Church spire -	1276	27 04 06 S.	70 50 10 W.	4 43 20.7
Coquimbo -	Church spire -	574	29 57 05 S.	71 21 13 W.	4 45 24.9
Valparaiso -	Monument, formerly Exchange cupola.	1314	33 02 07 S.	71 38 36 W.	4 46 34.4
Santiago -	Observatory -	789	33 26 42 S.	70 41 36 W.	4 42 46.4
Port Famine -	Observation spot +	547	53 38 37 S.	70 56 37 W.	4 43 46.5
Punta Arenas -	Old boat house +	545	53 09 53 S.	70 54 03 W.	4 43 36.2

MERIDIANS NOW ADOPTED ON FOREIGN GOVERNMENT
CHARTS (1915).

On all foreign Government charts the meridian of Greenwich is now adopted, with the exception of the Netherlands Government charts of Holland.

On the Netherlands Government charts of Holland the meridian of Amsterdam, Wester Kerk, West Tower, is used; this is assumed to be in long. $4^{\circ} 53' 02''$ E. from Greenwich.

France formerly used the meridian of Paris Observatory, assumed to be in long. $2^{\circ} 20' 14''$ E. from Greenwich.

Portugal formerly used the meridian of Lisbon Castle Observatory, assumed to be in long. $9^{\circ} 07' 55''$ W. from Greenwich.

Spain formerly used the meridian of Cadiz (San Fernando) Observatory, assumed to be in long. $6^{\circ} 12' 20''$ W. from Greenwich.

Russia formerly used the meridian of Pulkowa Observatory, assumed to be in long. $30^{\circ} 19' 39''$ E. from Greenwich.

The meridian of Ferro, Canary Islands, referred to in some old charts, is a meridian conventionally assumed to be in long. 20° W. from Paris, or $17^{\circ} 39' 46''$ W. from Greenwich.

DATUMS USED ON CHARTS.

In using any chart the title and notes should always be consulted, as there may be charts in which the general system is not followed.

CHARTS.	DATUM.		DATUM.		REMARKS.
	Soundings.	Heights of drying Banks, Rocks, &c.	Heights on Land.	Tidal Rises.	
ARGENTINE - -	Mean low water spring tides.	As soundings.	Mean high water spring tides.	As soundings.	Soundings expressed in pies = English feet, or brazas = English fathoms. Heights expressed in pies = English feet.
AUSTRIAN - -	Mean of all low waters.	As soundings.	Mean sea level [except lights, the datum for which is mean high water].	As soundings.	Soundings and heights expressed in metres.
BELGIAN - -	0.52ft. above mean low water spring tides at Ostend.	As soundings.	As soundings.	As soundings.	Soundings expressed in decimetres or metres. Heights expressed in metres.
BRAZILIAN - -	Low water of equinoctial spring tides.	—	Mean sea level [except lights, the datum for which is highest tide level].	Mean sea level	Soundings and heights expressed in metres.
BRITISH - -	Mean low water spring tides.	As soundings.	Mean high water spring tides.	As soundings.	Soundings expressed in feet or fathoms. Heights expressed in feet.
CANADIAN - -	Mean low water spring tides.	As soundings.	Mean high water spring tides.	As soundings.	Soundings expressed in feet or fathoms. Heights expressed in feet.

DATUMS USED ON CHARTS—continued.

CHARTS.	DATUM.		DATUM.		REMARKS.
	Soundings.	Heights of drying banks, rocks, &c.	Heights on Land.	Tidal Rises.	
CHILIAN - - -	Mean low water spring tides.	As soundings.	Mean high water spring tides.	As soundings.	Soundings and heights expressed in metres.
CHINESE - - -	Mean low water spring tides [except Yangtse and Wusung rivers, the datum for which is mean low water of extraordinary spring tides].	As soundings.	Mean high water spring tides.	As soundings.	Soundings expressed in feet or fathoms (English). Heights in expressed feet.
*DANISH - - -	Mean low water spring tides [except in <i>Kattegat</i> and <i>Baltic</i> , the datum for which is mean sea level.]	As soundings.	Mean sea level.	As soundings.	Soundings expressed in metres, or in fad=0.315 metro, or fath=1.88 metres. [Heights expressed in metres, or in fad=0.315 metres.
FRENCH - - -	Lowest observed low water.	As soundings.	Mean sea level [except lights, the datum for which is highest high water].	As soundings.	Soundings and heights expressed in metres.
†GERMAN - - -	Mean low water spring tides [except in <i>Baltic</i> , the datum for which is mean sea level; and in the <i>North Sea</i> , the datum for which is 0.3 metre below mean low water spring tides.]	As soundings.	Normal zero (N.N.), which is approximately mean sea level for <i>Baltic</i> and <i>North Sea Coasts</i> . Mean low water spring tides for German Colonial Charts. [In reproducing charts by other Governments the heights are given unaltered.]	As soundings.	Soundings and heights expressed in metres.

* On most recent DANISH charts the soundings and heights are given in metres.

† On most recent GERMAN charts of the North Sea coasts the datum is one foot below mean M.L.W.S.

DATUMS USED ON CHARTS—*continued.*

CHARTS.		DATUM.		DATUM.		REMARKS.
		Soundings.	Heights of drying Banks, Rocks, &c.	Heights on Land.	Tidal Rises.	
INDIAN MARINE SURVEY.		Mean low water spring tides.	As soundings.	Mean high water spring tides.	As soundings.	Soundings expressed in feet or fathoms. Heights expressed in feet.
ITALIAN -		Mean low water spring tides.	Mean sea level.	Mean sea level.	As soundings.	Soundings and heights expressed in metres.
JAPANESE		Mean low water spring tides.	As soundings.	Mean high water spring tides.	As soundings.	Soundings expressed in feet or fathoms (English). Heights expressed in feet.
NETHERLANDS		Mean low water spring tides [except for Netherlands, the datum for which is mean level of <i>all</i> low waters].	As soundings.	Mean high water spring tides [except for Netherlands, the datum for which is mean sea level].	As soundings.	Soundings expressed in vadam=1.8 metres, or metres or decimetres. Heights expressed in metres. [On older charts heights were expressed in voet=0.3 metre].
NORWEGIAN		Mean low water spring tides.	Not given on charts.	Mean sea level [coast line is the level of high water springs.]	Not given on charts.	Soundings and heights expressed in metres.
PORTUGUESE		Lowest water level [=low water of equinoctial spring tides].	—	Mean sea level.	As soundings.	Soundings and heights expressed in metres.
RUSSIAN -		Lowest observed low water [in non-tidal seas, mean sea level].	As soundings.	Mean sea level.	As soundings.	Soundings expressed in fut=English foot, or sazhen=English fathom. Heights expressed in fut=English foot.

DATUMS USED ON CHARTS—*continued.*

CHARTS.	DATUM.		DATUM.		REMARKS.
	Soundings.	Heights of drying Banks, Rocks, &c.	Heights on Land.	Tidal Rises.	
SPANISH - - -	Low water of equinoctial spring tides.	As soundings.	Mean sea level.	As soundings [equinoctial tides given].	Soundings and heights expressed in metres.
SWEDISH - - -	Mean low water, which is 1ft to 2ft. below mean sea level [on some plans, mean sea level].	Not given on charts.	Mean sea level at Stockholm	Not given on charts.	Soundings and heights expressed in metres.
UNITED STATES COAST AND GEO- DETTIC SURVEY.	Atlantic Coasts and West Indies: Mean of all low waters.	As soundings.	Approximately mean high water, [Philippines and Boston Bay, U.S. mean sea level.]	As soundings.	Soundings expressed in foot or fathoms. Heights expressed in feet or metres.
	Pacific Coasts [Mexico to Puget Sound] and Philippines: Mean of all lower low waters.	As soundings.			
	Alaska and Coasts north of Puget Sound: Harmonic or Indian tide plane [=approximately lowest low water].	Mean of all lower low waters. [Panama: Mean low water spring tides.] [Puget Sound: 2ft. below mean of all lower low waters.] [Wrangell sound: 3ft. below mean of all lower low waters.]			

DATUMS USED ON CHARTS—continued.

CHARTS.	DATUM.		DATUM.		REMARKS.
	Soundings.	Heights of Drying Banks, Rocks, &c.	Heights on Land.	Tidal Rises.	
UNITED STATES HYDROGRAPHIC OFFICE.	<p>Mean of all low waters. [U.S. coasts same as U.S.C. and G.S.]</p> <p>[Great lakes: <i>Since March 1909</i> to standard levels slightly below mean levels; for Superior, 600.5ft.; Huron, 578.5ft.; Michigan, 578.5ft.; Erie, 570ft.; and Ontario, 243ft. above mean tide level at New York.</p> <p><i>From October 1901 to March 1909</i> the levels used for Superior, Huron, and Michigan were 0.5ft. lower.</p> <p><i>And previous to October 1901</i> were for Superior, 1.27ft.; Huron, 2.78ft.; Michigan, 2.78ft.; Erie, 2.39ft.; and Ontario, 3.11ft. higher than those used since March 1909.]</p>	As soundings.	Mean high water.	As soundings.	<p>Soundings expressed in feet or fathoms.</p> <p>Heights expressed in feet.</p>
UNITED STATES LAKE SURVEY.	Same as U.S. H.O. above.	—	Mean lake level.	—	Soundings and heights expressed in feet.

SECTION VIII.

LIST OF PUBLICATIONS

OF

HYDROGRAPHIC DEPARTMENT

NOTE:—Copies of many of these are not available for issue.

Title of Publication.

- No. 1. On collecting plants and their products. (1833)
- No. 2. Instructions for using Mr. Fox's instrument for determining the magnetic inclination and intensity. (1842)
- No. 3. Hydrographic Notices on Currents, by Colonel E. Sabine, R.A. (1845)
- No. 4. Reports on the harbours of Appledore, Bideford, and Barnstaple. (1848)
- No. 5. A Table for finding the Latitude from the Altitude of the Polar Star, observed at any hour in the Northern Hemisphere, by W. Salmon, Naval Instructor, H.M.S. "Bellerophon." (1850)
- No. 6. Remarks upon the Tidal Phenomena of the River Severn, and a description of the strata passed through in boring into the bed of the river, Captain F. W. Beechey, R.N., F.R.S. (1851)
- No. 7. Table of positions, New Zealand, from the surveys of H.M. ships "Acheron" and "Pandora," 1848-55. (1856)
- No. 8. Deep Sea soundings in the Mediterranean Sea, East of Malta, by Captain T. Spratt, R.N., C.B., obtained in 1856-7. (1857)
- No. 9. Deep Sea soundings in the N. Atlantic Ocean, between Ireland and Newfoundland, made in H.M.S. "Cyclops," Lieutenant and Commander Joseph Dayman, in June and July, 1857. (1858)
- No. 10. Currents of Sea of Marmora, Dardanelles, &c. Experiments and results on, Captain T. Spratt, "Medina," 30th March, 1858. (1858)
- No. 11. Deep Sea soundings. Abstract of trials for Ocean Soundings made by H.M. ships between 1840-58, and in ships of U.S. Navy from 1849 to 1856. Compiled by F. J. Evans, Master, R.N. (1858)
- No. 12. Methods of ascertaining the Distance from Ships at sea, by Captain A. P. Ryder, R.N., F.R.G.S. 3rd edition. (1858)
- No. 13. On the present state of the Coast Survey in India, China, the Asiatic Archipelago, and Australia. (1859)
- No. 14. Deep Sea soundings in N. Atlantic Ocean, between Newfoundland, the Azores, and England, made in H.M.S. "Gorgon" (Commander Joseph Dayman, R.N.) in September and October, 1858. (1859)

Title of Publication.

No. 15. Deep Sea soundings in Bay of Biscay and Mediterranean Sea, made by H.M.S. "Firebrand" (Commander Joseph Dayman, R.N.) in summer of 1859. (1860)

No. 16. Remarks on the Sounding Voyage of H.M.S. "Bulldog," 1860 (Atlantic). (1861)

No. 17. General Instructions for Hydrographic Surveyors of the Admiralty. (1862)

No. 18. The North Atlantic sea bed. A diary of the voyage on board H.M.S. "Bulldog" in 1860, by G. C. Wallich, M.D., F.L.S., F.G.S. (1862)

No. 19. Deep Sea Soundings. West of Ireland, by Mr. R. Hoskyn, Master and Surveyor, H.M.S. "Porcupine," June, July, and August, 1862. (1862)

No. 20. Table for converting French mètres and décimètres into English feet and fathoms, by R. C. Carrington, F.R.G.S., 1865. (1865)

No. 21. A Diagram and Table for deducing the Meridian Altitude from Two Altitudes observed near the Meridian, by Professor Giorgio Foscolo, of Venice. (1867)

No. 22. Notes on Deep Sea Sounding, by Staff-Commander J. E. Davis, R.N. (1867)

No. 23. Tables for finding the Longitude by chronometer at sunrise and sunset, by Commander H. B. Weston, I.N. (1867)

No. 23A. Report on Deep Sea Dredging, Sounding, and Temperature between Scotland and the Færoe Isles, in H.M.S. "Lightning." (1868)

No. 24. Memoir of Hydrographical Department of the Admiralty, 1868. (1868)

No. 25. Report of Staff-Commander E. K. Calver on the proposed harbour in South Bay, Wexford. (1868)

No. 26. Report on the effects of the Earthquake Wave which occurred in the West Indies in November, 1867, by Staff-Commander John Parsons, R.N., West India Survey. (1868)

No. 27. Sounding voyage of H.M.S. "Hydra," Captain P. F. Shortland, 1868. (1869)

No. 28. China; East Coast—Remarks on the general sheets of the East Coast of China Survey, from Hong Kong to Shanghai, with suggestions for improving them, by Commander E. W. Brooker, R.N., H.M.S. "Sylvia." (1869)

No. 28A. Report on the Extension of the Telegraph by a submarine cable from Java towards Australia, by Commander C. Bullock, H.M.S. "Serpent," 10th March, 1869. (1869)

No. 29. Remarks explaining the fittings used and the mode of obtaining Deep Sea soundings between the English and Newfoundland Banks during the months of April and May 1869, by Navigating-Lieutenant V. F. Johnson, R.N. (1869)

Title of Publication.

No. 30. Report on the Suez Canal, with directions for its pilotage, by Commander G. S. Nares, H.M.S. "Newport," November, 1869. (1869)

No. 31. Report on the Maritime Canal connecting the Mediterranean at Port Said with the Red Sea at Suez, by Captain Richards, R.N., F.R.S., Hydrographer, and Lieutenant-Colonel Clarke, C.B., R.E., Director of Works, Admiralty. (1870)

No. 32. Report on the sites for additional Red Sea Lights, by Commander W. Chimmoo, H.M.S. "Nassau." (1870)

No. 33. Table for converting French mètres and décimètres into English feet and fathoms, by R. C. Carrington, F.R.G.S., 2nd edition. (1871)

No. 34. East India Charts—A return showing new charts engraved, and additions and corrections made to those received from the India Office, between January, 1861, and June, 1871. (1871)

No. 35. Investigation of the Gibraltar Strait Current, by Captain G. S. Nares, H.M.S. "Shearwater," 1871. (1872)

No. 35A. Report on the Currents of the Dardanelles and Bosphorus, by Captain W. J. L. Wharton, 1872. (1872)

No. 36. Report on the Suez Canal, April, 1871, by Captain G. S. Nares, H.M.S. "Newport." (1872)

No. 37. Six's self-registering Deep Sea Thermometer (Miller Pattern). Directions for use, by Captain J. E. Davis, R.N. (1872)

No. 38. Observations on the Determination of Longitudes between Malta and Bombay by means of the electro-magnetic telegraph, made by Officers of the Royal Navy between 1860 and 1870. (1872)

No. 38A. Touring of H.M. Indian troop ships through the Suez Maritime Canal. Memorandum from Rear-Admiral G. H. Richards, Hydrographer, dated Admiralty, 28th April, 1873. (1873)

No. 39. Hydrographical extract from a six months' cruise among the South Sea Islands. H.M.S. "Blanche." (1873)

No. 40. Table for converting French mètres into English feet and fathoms (from 1 to 2,000), by R. C. Carrington, F.R.G.S., 3rd edition. (1873)

No. 41. Information received from Master of Schooner "Franz" on the Western Islands of the Pacific Ocean and New Guinea. (1873)

No. 42. Tables of positions in the Pacific Ocean, by Captain Denham, R.N., F.R.S., in H.M.S. "Herald," 1852-1860. (1873)

No. 43. List of Scientific Instruments, Dredging, and Sounding Apparatus, &c., on board H.M.S. "Challenger," 1873. (1873)

No. 44. Visit to Island of Formosa, by H.M.S. "Salamis," 1873. (1874)

No. 45. Notes on the late cruise of H.M.S. "Cameleon" amongst the South Pacific Islands, 1873. (1874)

Title of Publication.

No. 46. Remarks on Amsterdam Island, Indian Ocean, by Navigating-Lieutenant H. Hosken, R.N., H.M.S. "Pearl," 1873. (1874)

No. 47. H.M.S. "Challenger." Reports of Captain G. S. Nares, R.N., with Abstract of Soundings, and Diagrams of Ocean Temperatures, in North and South Atlantic Oceans, 1873. (1874)

No. 48. H.M.S. "Challenger," No. 2. Reports on Ocean Soundings and Temperature: Antarctic Sea, Australia, New Zealand, 1874. (1874)

No. 49. Memorandum on the Chart of the Makrán Coast, by Lieutenant A. W. Stiffe, late I.N. (1874)

No. 50. Table showing the length, in Cables, of a Minute of Longitude, corresponding to a Mile of Latitude, for every 10 Minutes of the Quadrant, by R. C. Carrington, F.R.G.S. (1874)

No. 51. H.M.S. "Challenger," No. 3. Reports on Ocean Soundings and Temperature: New Zealand to Torres Strait, Torres Strait to Manila and Hong Kong, 1874. (1875)

No. 52. Report to Hydrographer of the Admiralty accompanying the Survey of Port Said, and its approaches, made in the early part of 1875, by Navigating-Lieutenant John Millard, R.N., Malta, 28th April, 1875. (1875)

No. 53. H.M.S. "Challenger," No. 4. Report on Ocean Soundings and Temperatures: Pacific Ocean, China, and adjacent Seas, 1875. (1875)

No. 54. Report to the Hydrographer of the Admiralty of the Depths obtained in the Suez Canal by H.M. Surveying Ship "Shearwater," on passage through from Suez to Port Said, June 13th and 14th, 1875, by Commander W. J. L. Wharton. (1875)

No. 55. H.M.S. "Challenger," No. 5. Report on Ocean Soundings and Temperatures: Pacific Ocean, 1875. (1875)

No. 56. H.M.S. "Valorous." Deep Sea Soundings and Temperatures: N. Atlantic Ocean, 1875. (1875)

No. 57. Manual of Instructions for the Arctic Expedition, 1875. (1875)

No. 58. H.M.S. "Challenger," No. 6. Report on Ocean Soundings and Temperatures: Pacific Ocean, 1875. (1876)

No. 59. Azimuth Table to show the Bearing of the Sun, by A. C. Johnson. (1876)

No. 60. The "Valorous" Expedition. Preliminary report of the Biological Results of a cruise in H.M.S. "Valorous" to Davis Strait in 1875, by J. Gwyn Jeffreys, LL.D., F.R.S. (From Proceedings of Royal Society, No. 173, 1876.) (1876)

No. 60a. Return of all Surveys of the Coasts of Ireland and Scotland, published by authority of the Hydrographic Department of the Admiralty. Parliamentary Paper. (1876)

Title of Publication.

No. 61. H.M.S. "Challenger," No. 7. Report on Ocean Soundings and Temperatures, Atlantic Ocean, 1876. (1876)

No. 62. Directions for reducing Tidal Observations, by John Burdwood, Staff-Commander, R.N. (1876)

No. 63. H.M.S. "Challenger." Contributions to the Meteorology of Japan, by Staff-Commander T. H. Tizard, 1876. (1876)

No. 63A. Surface Currents observed by H.M.S. "Fawn" between Damietta and Om Fareg, 1876. (1876)

No. 64. Remarks on the Surveys of the Coast between Damietta and Om Fareg, and of Port Said, in H.M. Surveying Ship "Fawn," September and October, 1876. Commander W. J. L. Wharton, H.M.S. "Fawn." (1877)

No. 65. General Instructions for Hydrographic Surveyors. (1877)

No. 66. Report on a survey of Port Said, made by Staff-Commander J. Millard, August, 1877. (1878)

No. 67. Information on the present state of Maritime Meteorology, by Captain F. J. Evans, R.N., Hydrographer. (1878)

No. 68. Atlases, Charts, and Books on Ocean Meteorology, compiled and published by the Hydrographic Department of the Admiralty, with their authorities, to May, 1877. (1878)

No. 68A. Baltic and Gulf of Finland—Hydrographic memoranda. (1878)

No. 69. Memorandum on the anchorages of Cyprus, and on other questions, chiefly nautical, connected with that island. By the Hydrographer to the Admiralty (accompanied with a plan of Famagusta harbour, from an Admiralty Survey in progress), 1878. (1879)

No. 70. Memorandum on Port of Alexandria, prepared by the Hydrographer of the Admiralty, after a personal examination made of that Harbour in November, 1878. (1879)

No. 71. Notes on Deep Sea Sounding. (1879)

No. 72. Atlantic, Indian, and Pacific Oceans: Distances under steam and sail. Hydrographic Department, 1879 (1879)

No. 73. Visit to Pitcairn's Island, by H.M.S. "Opal," 1879. (1879)

No. 74. Atlantic Ocean—Navigable distances in nautical miles. (1879)

No. 75. Report on Admiralty Surveys for the year 1879, by the Hydrographer. Parliamentary Paper. (1881)

No. 76. Report on Admiralty Surveys for the year 1880, by the Hydrographer. Parliamentary Paper. (1881)

No. 77. A review of Oceanic or Maritime Discovery, Exploration and Research, as made in the half century, 1831-81. (A paper prepared by the Hydrographer, and read at the Meeting of the British Association, held in York, September, 1881.) (1881)

Title of Publication.

- No. 78. A new method of clearing the Lunar Distance, by Sir G. B. Airy, K.C.B., F.R.S. (1881)
- No. 79. Report on Admiralty Surveys for the year 1881, by the Hydrographer. Parliamentary Paper. (1882)
- No. 80. Report on Admiralty Surveys for the year 1882, by the Hydrographer. Parliamentary Paper. (1883)
- No. 81. Report on Admiralty Surveys for the year 1883, by the Hydrographer. Parliamentary Paper. (1884)
- No. 82. General Instructions for Hydrographic Surveyors. (1884)
- No. 83. Volcanic eruption in Sunda Strait. Extracts from Report by Commander the Honourable F. C. P. Vereker, H.M.S. "Magpie," 22/10/83. (Proceedings of Royal Society, No. 229/84.) (1884)
- No. 84. Report on Admiralty Surveys for the year 1884, by the Hydrographer. Parliamentary Paper. (1885)
- No. 85. Observations required off Ras Asir. Captain W. J. L. Wharton, Hydrographer, October, 1885. (1885)
- No. 86. Report on Admiralty Surveys for the year 1885, by the Hydrographer. Parliamentary Paper. (1886)
- No. 87. Supplement to General Instructions for Hydrographic Surveyors. (1886)
- No. 88. Report on the Currents of the Dardanelles and Bosphorus, by Commander W. J. L. Wharton, 1872. (1886)
- No. 89. Memorandum on Use of Oil at Sea, for modifying the effect of Breaking Waves. (Enclosure No. 16 to Guard Book, containing Special Memoranda.) (1886)
- No. 90. Report on Admiralty Surveys for the year 1886, by the Hydrographer. Parliamentary Paper. (1887)
- No. 91. Christmas Island (Indian Ocean), Report on Zoological Collection made by the Officers of H.M.S. "Flying Fish." (Proceedings of Zoological Society, 23/6/87.) (1887)
- No. 92. Instructions to Officers in charge of Admiralty Surveys. (1887)
- No. 93. Spheroidal Tables, by R. C. Carrington, 1887. (1887)
- No. 94. Report on Admiralty Surveys for the year 1887, by the Hydrographer. Parliamentary Paper. (1888)
- No. 95. Report on Christmas Island (Indian Ocean), by Captain P. Aldrich, H.M.S. "Egeria," 1887. (1888)
- No. 96. Deep Sea Soundings and Serial Temperature Observations obtained in the Indian Ocean, by Captain P. Aldrich, H.M. Surveying Vessel "Egeria," 1887. (1888)
- No. 97. Report on Sounding Cruise of H.M.S. "Egeria," by Captain P. Aldrich, Indian Ocean, 1887. (1888)

Title of Publication.

No. 98. Determination of the difference of Longitude between Gibraltar and Malta, by Lieutenants G. C. Frederick and H. H. Douglas, of H.M.S. "Sylvia," 1886. (1888)

No. 99. Account of Christmas Island (Indian Ocean), by Captain W. J. L. Wharton, Hydrographer (from Royal Geographical Society's Proceedings, October, 1888). (1888)

No. 100. Report on Bore of Tsien Tang Kiang, by Commander Moore, H.M.S. "Rambler," 1888. (1888)

No. 101. General Instructions for Hydrographic Surveyors. (1888)

No. 101A. Comparison of length of passage from Portsmouth to certain ports in the East by various routes. (1888)

No. 102. Table of Chords, by Navigating-Lieutenant T. H. Tizard, R.N. (1888)

No. 103 Report on Admiralty Surveys for the year 1888, by the Hydrographer. Parliamentary Paper. (1889)

No. 104. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1888 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1889)

No. 105. Course signals for ships in fogs: Captain Colomb's scheme, 1882. (Enclosure in Portsmouth Letter, No. 930, of 1882). (1889)

No. 106. China Sea—Reports of the results of an examination, by the Officers of H.M.S. "Rambler" of the Slopes and Zoological condition of Tizard and Macclesfield Banks, 1888. (1889)

No. 107. Depths in the Harbours and Approaches to the Principal Ports of Great Britain. (1889)

No. 108. Search for reported dangers in South Pacific, between New Zealand and Tonga Islands, made by Captain P. Aldrich, H.M.S. "Egeria," 1888. (1889)

No. 109. Report on respective advantages of Transit Instrument and Sextant, for exact observations connected with Hydrographical Surveying, by Commander A. M. Field and Lieutenant H. E. Pureycust, 1889. (1889)

No. 110. A Report on the movements of the Ice, Currents, and Tidal Streams on coast of Newfoundland and in the Gulf of St. Lawrence, by Commander G. Robinson, R.N. (1889)

No. 111. Turning Trials of H.M. Ships, from experiments at Portland, September, 1889. (1889)

No. 112. Report on Admiralty Surveys for the year 1889, by the Hydrographer. Parliamentary Paper. (1890)

No. 113. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1889 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1890)

Title of Publication.

- No. 114. Report on the survey of the Outer part of the Thames Estuary, with information on the Tidal Datums used at various places on the East Coasts of England and Scotland, by Staff-Captain Tizard, R.N. (1890)
- No. 115. Search for reported dangers in South Pacific, between New Zealand and the Tonga Islands, also between Fiji and the Tonga Islands, by Commander C. F. Oldham, H.M.S. "Egeria," 1889. (1890)
- No. 116. Longitudes, West Coast of Africa. Telegraphic determinations by Commander T. F. Pullen, R.N., and W. H. Finlay, of Cape Observatory. (1890)
- No. 117. Report on Admiralty Surveys for the year 1890, by the Hydrographer. Parliamentary Paper. (1891)
- No. 118. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1890 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1891)
- No. 119. Notes on the Tidal Streams at the entrance to the English Channel by H.M.S. "Research," Captain P. Aldrich, 1889-90. (1891)
- No. 120. Supplement to a Report on the movements of the Ice, &c., on the Coast of Newfoundland, by Commander G. Robinson, R.N. (1891)
- No. 121. Notes on the Tidal Datums and Levels of the Thames River and Estuary, compiled by Staff-Captain T. H. Tizard, H.M.S. "Triton." (1891)
- No. 122. Longitudes, Western Australia. By Commander W. U. Moore and Lieut. J. F. Parry, H.M.S. "Penguin," and Mr. C. Todd, C.M.G., F.R.S., Government Astronomer, Adelaide. (1891)
- No. 123. Report on Admiralty Surveys for the year 1891, by the Hydrographer. Parliamentary Paper. (1892)
- No. 124. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1891 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1892)
- No. 125. Report on depths in Pinup and Gillingham Reaches, River Medway, with sectional soundings, by Staff-Captain T. H. Tizard, R.N., H.M.S. "Triton." (1892)
- No. 126. Stopping and Turning Trials of H.M. ships. (1892)
- No. 127. A Vocabulary in various dialects used in some Islands of the New Hebrides, South Pacific. Compiled by Lieutenant B. T. Somerville, R.N. (1892)
- No. 128. List of H.M. ships lost from all causes other than by the enemy from 1800 to 1891. (1892)

Title of Publication.

No. 129. Report on Admiralty Surveys for the year 1892, by the Hydrographer. Parliamentary Paper. (1893)

No. 130. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1892 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1893)

No. 131. Further report on the Bore of the Tsien Tang Kiang, by Captain W. U. Moore, R.N., H.M.S. "Penguin." (1893)

No. 132. Report on the results of Dredgings obtained on the Macclesfield Bank, April, 1892, by H.M.S. "Penguin," Commander W. U. Moore, R.N. (1893)

No. 133. Remarks on a method of obtaining time by Equal Altitudes of two stars on opposite sides of the Meridian, by Commander A. M. Field, R.N., H.M.S. "Egeria." (1893)

No. 134. System of Orthography adopted by the Admiralty for Sailing Directions and Charts. (1893)

No. 135. System of Orthography adopted by Germans. (1893)

No. 135A. Supplement to General Instructions for Hydrographic Surveyors, 1888. (1893)

No. 136. Report on Admiralty Surveys for the year 1893, by the Hydrographer. Parliamentary Paper. (1894)

No. 137. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1893 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1894)

No. 138. Report on an Experimental Telegraphic Meridian Distance between Adelaide and Port Darwin, to test the relative merits of Sextant and Transit Instrument for purposes connected with Hydrographical Surveying, by Commander W. U. Moore, R.N. (1894)

* No. 139. Compasses. A series of questions and answers relating to Compasses, their errors and corrections, comprising the course of instruction for acting sub-lieutenants. (1894)

No. 140. Table of Chart Scales expressed in inches to the mile of latitude with their corresponding natural scales, by E. J. Powell, Hydrographic Office. (1894)

No. 141. Deep Sea Exploration in Faerøe Channel, by H.M.S. "Triton," Staff-Commander T. H. Tizard, R.N., 1882. (1894)

No. 142. Longitude of Malacca, Straits Settlements, determined by means of Telegraphic Signals exchanged with Singapore, 1893, by Commander A. M. Field and Officers of H.M. Surveying Vessel "Egeria." (1894)

No. 143. Report on the results of Dredgings obtained on the Macclesfield Bank, in H.M.S. "Rambler," 1888, H.M.S. "Penguin," 1892, H.M.S. "Egeria," 1893. (1894)

Title of Publication.

No. 144. Longitude of Penang, Straits Settlements, determined by means of Telegraphic Signals exchanged with Singapore, December, 1893, by Commander A. M. Field, Lieutenant W. H. D. Margesson, H.M.S. "Egeria," and Mr. A. Sutherland, of Observatory, Singapore. (1894)

No. 145. Index of 800 Stars to the 4.5 magnitude, arranged according to both right ascensions and declinations, and giving the Star Catalogues in which they are to be found. Compiled by Lieutenant B. T. Somerville, R.N., for the use of Nautical Surveyors. (1894)

No. 146. Report on Admiralty Surveys for the year 1894, by the Hydrographer. Parliamentary Paper. (1895)

No. 147. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1894 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1895)

No. 148. Tables for facilitating the Calculation of Heights. Compiled by Commander H. E. Purey-Cust, R.N., 1894. (1895)

No. 148a. Tables for facilitating the Calculations of Heights. Compiled by Commander H. E. Purey-Cust, R.N., 1894. Pocket size. (1895)

No. 149. Hydrographical Notice, 1895, relating to Spitzbergen. (1895)

No. 150. Remarks by Commodore G. L. Atkinson, H.M.S. "Active," relative to the cruise of the Training Squadron to Spitzbergen, 1895. (1895)

No. 151. Report on Admiralty Surveys for the year 1895, by the Hydrographer. Parliamentary Paper. (1896)

No. 152. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1895 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1896)

No. 153. Report on the Eruption of Ambrym Island, New Hebrides, S.W. Pacific, October and November, 1894, by Commander H. E. Purey-Cust, R.N., H.M.S. "Dart." (1896)

No. 154. Report of Proceedings in connection with investigations into the physical conditions of the water of the Faeroe Channel, by Captain W. U. Moore, R.N., H.M.S. "Research." (1896)

No. 155. Instructions for writing, editing, and revising Sailing Directions. (1896)

No. 156. A Vocabulary of various dialects used in New Georgia, Solomon Islands. Compiled by Lieutenants B. T. Somerville and S. C. Weigall, R.N., H.M.S., "Penguin," 1893-5. (1896)

Title of Publication.

No. 157. Report on Admiralty Surveys for the year 1896, by the Hydrographer. Parliamentary Paper. (1897)

No. 158. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1896, from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1897)

No. 159. Search for reported dangers in South Pacific to the northward of Fiji, and for La Brillante shoal and Melanie Rock, by H.M. Ships "Penguin" and "Waterwitch," 1895-6. (1897)

No. 160. Report on Admiralty Surveys for the year 1897, by the Hydrographer. Parliamentary Paper. (1898)

No. 161. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1897 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1898)

No. 162. Report on Palmyra and Fanning Islands as to their suitability and capabilities as submarine cable stations, by Captain A. M. Field, H.M.S. "Penguin," 1897. (1898)

* No. 163. Compasses. A series of questions and answers relating to Compasses, their errors and corrections, comprising the course of instruction for acting sub-lieutenants. (1898)

No. 164. Report of the Under-currents in the Straits of Babel-Mandeb, from observations by Lieutenant and Commander H. J. Gedge, H.M.S. "Stork." (1898)

No. 165. Richard Tide Gauge. General description of, and Instructions for use, by Captain W. U. Moore, H.M.S. "Research." (1898)

No. 166. Report on Admiralty Surveys for the year 1898, by the Hydrographer. Parliamentary Paper. (1899)

No. 167. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1898 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1899)

No. 168. Report on Observations of the Tidal Currents and Under-currents in the Strait of Dover, made with a deep sea current meter, by Captain W. U. Moore, H.M.S. "Research," 1896. (1899)

No. 169. Report on Admiralty Surveys for the year 1899, by the Hydrographer. Parliamentary Paper. (1900)

No. 170. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1899, from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1900)

No. 171. System of Orthography, adopted by the Admiralty, for Sailing Directions and Charts. (1900)

Title of Publication.

No. 172. Report on the Under-currents in the River Congo, West Africa, from observations by Commander H. E. Purey-Cust, R.N., H.M.S. "Rambler," 1899. (1900)

No. 173. Report on Sounding Cruise of H.M.S. "Egeria" on the proposed Pacific Cable route, by Lieutenant B. T. Somerville, R.N., 1899. (1900)

No. 174. Chronological list of the Officers conducting British maritime discoveries and surveys; together with the names of the vessels employed, from the earliest times until 1900. Compiled by Captain T. H. Tizard, R.N. (1900)

No. 175. The method of formation of tables for approximately predicting complicated tides, using an abstract diagram. (1900)

No. 176. Report on the Navigation of the Upper Yangtse between Ichang and Sui Fu, with descriptions of the Rapids, by Lieutenant-Commander H. E. Hillman, R.N., H.M.S. "Woodlark," 1900. Errata and Addenda to above. (1901)

No. 177. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1900 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1901)

No. 178. Report on Admiralty Surveys for the year 1900. Parliamentary Paper. (1901)

* No. 179. List of Magnetic Observations made by Officers of H.M. ships and Indian Marine Survey, 1890-1900. (1901)

No. 180. Appendix to the Report on the Navigation of the Upper Yangtse, by Lieutenants Watson and Hillman, R.N., 1900. Description of the Navigation and Rapids from Chung King to Lu Chau, by Lieutenant R. E. Chilcott, R.N., and a Report on the Navigation of the Min River (Yangtse), from Sui Fu to Kiang Kau, by Mr. S. C. Plant, H.M.S. "Pioneer." (1901)

No. 181. Further Report by Lieutenant and Commander H. D. Watson, R.N., of H.M.S. "Woodcock," on the navigability of the Upper Yangtse and tributaries, and on the trade carried thereon. (Yangtse No. 2.) Addendum to above. (1901)

No. 182. Report on the Navigation of the Tung Ting Lake and the Siang and Yuen Rivers (Upper Yangtse), with descriptions of Chang Sha, Siang Tan, Chang Teh, by Lieutenant and Commander H. E. Hillman, R.N., H.M.S. "Woodlark." (Yangtse No. 3.) (1902)

No. 183. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1901, from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1902)

No. 184. Report on Admiralty Surveys for the year 1901. Parliamentary Paper. (1902)

Title of Publication.

- No. 185. General Instructions for Hydrographic Surveyors, 1902. (1902)
- No. 186. Report on Observations of the Tidal Currents and Under-currents in the Strait of Dover, made with a deep sea current meter, by M. F. J. Wilson, Esq., M.I.C.E., and Captain Field, R.N., H.M.S. "Research," 1900-1901. (1902)
- No. 187. Report on the Navigation of the Han Kiang (Yangtse), with Sailing Directions and a Map, by Lieutenant and Commander W. R. Dalgety, R.N., H.M.S. "Teal." (Yangtse, No. 4.) (1902)
- No. 188. Report by Lieutenant and Commander R. E. Chilcott, R.N., H.M.S. "Woodlark," on the Navigability of Tributaries of the Upper Yangtse, from Chung King to Ho Chau on the Kialing Kiang, and from Ho Chau to Ngan Dhu Shien on the Fu Kiang, with additional notes on the possibilities of navigating the Upper Waters of these Tributaries. (Yangtse, No. 5.) (1903)
- No. 189. Report on Sounding without Tubes, from the Fore part of Ship, with Thomson's Sounding Machine, by Captain A. M. Field, R.N., H.M.S. "Research." (1903)
- No. 190. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1902 from H.M. surveying ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1903)
- No. 191. Report on the Navigability of the Kialing Kiang (or Chung King Siao Ho) and the Fu Ho (or Min river), two tributaries of the Upper Yangtse Kiang, by Lieutenant and Commander H. C. Somerville, R.N., H.M.S. "Woodcock." (1903)
- No. 192. Report on Admiralty Surveys for the year 1902. Parliamentary Paper. (1903)
- No. 193. Instructions to Officers in charge of Surveys. (Personal). (1903)
- No. 194. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1903, from H.M. Surveying Ships, Indian Marine Survey, and British Submarine Telegraph Companies. (1904)
- No. 195. Report on Admiralty Surveys for the year 1903. Parliamentary Paper. (1904)
- No. 196. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1904, from H.M. Surveying Ships, Indian Marine Survey, Antarctic Exploring Vessels, and British Submarine Telegraph Companies. (1905)
- No. 197. Report on Admiralty Surveys for 1904. Parliamentary Paper. (1905)
- * No. 198. List of Observations for Variation of the Compass, made by Officers of H.M. ships, Indian Marine Survey, and National Antarctic vessel "Discovery," during the years 1900-5. (1905)

Title of Publication.

No. 199. List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year 1905, from H.M. Surveying Ships and British Submarine Telegraph Companies. (1906)

No. 200. Instructions for investigating Magnetic Shoals. (1906)

No. 201. Telegraphic Determination of Longitude of St. Helena. (1906)

No. 201A. Telegraphic Determination of Longitude of Accra. (1906)

* No. 202. List of Spots suitable for Magnetic Observations and list of places where abnormal variations have been reported. (1906)

No. 203. Report on Admiralty Surveys for the year 1905. Parliamentary Paper. (1906)

No. 204. List of Oceanic Depths received at the Admiralty during the year 1906 from H.M. Surveying Ships and British Submarine Telegraph Companies. (1907)

* No. 205. List of Observations for Variation of the Compass for years 1905 and 1906. (1907)

No. 206. Report on Admiralty Surveys for the year 1906. Parliamentary Paper. (1907)

No. 207. Yangtse, No. 7. Supplement to the Report on the Navigation of the Han Kiang, with Sailing Directions and a Map, by Lieutenant and Commander T. J. S. Lyne, R.N., H.M.S. "Snipe." (1907)

No. 208. Report on Positions of Outer Light-Vessels of Thames Estuary, by Captain Smyth, H.M.S. "Research" (1905). (1907)

* No. 209. Results of Magnetic Observations for the years 1907 received from H.M. ships and the Royal Indian Marine. (1908)

* No. 210. Particulars of Spheres, Flinders Bar, Heeling Error Constants and λ_2 for Compasses of H.M. ships, 1908. (1908)

* No. 211. List of Spots suitable for Magnetic Observations and list of places where abnormal variations have been reported. (1908)

No. 212. List of Oceanic Depths received at the Admiralty during the year 1907 from H.M. Surveying Ships, Indian Marine Ships, and British Submarine Telegraph Companies and other sources. (1908)

No. 213. Report on Admiralty Surveys for the year 1907. Parliamentary Paper. (1908)

No. 214. Report on Determination of Difference of Longitude, Greenwich—Ascension—Cape. (1908)

No. 215. List of Oceanic Depths received at the Admiralty during the year 1908. (1909)

* No. 216. Results of Magnetic Observations for the year 1908, received from H.M. ships and Royal Indian Marine. (1909)

No. 217. Report on Admiralty Surveys for the year 1908. Parliamentary Paper. (1909)

No. 218. Reports on Utility of Range Finders for Surveying Service. (1909)

Title of Publication.

- * No. 219. Report on Magnetic Shoal in Storm Bay, Tasmania. (1909)
- No. 220. Remarks on rendering Triangulation Sheets for Hydrographic Surveys, by Captain F. C. Learmonth, R.N. (1909)
- No. 221. General Instructions for Hydrographic Surveyors. (1909)
- No. 222. Instructions to Officers in charge of Hydrographic Surveys. (1909)
- *No. 223. Particulars of Spheres, Flinders Bar, Heeling Error Constants, λ_2 , and Values of Constant C, for compasses of H.M. Ships. (1910)
- No. 224. List of Oceanic Depths and Serial Temperatures received at the Admiralty during the year 1909. (1910)
- No. 225. Report on Admiralty Surveys for the year 1909. Parliamentary Paper. (1910)
- * No. 226. Results of Magnetic Observations for year 1909. Received from H.M. ships and Royal Indian Marine. (1910)
- † No. 227. Half-yearly Report on Navigational Subjects, No. 1. (1910)
- † No. 228. Half-yearly Report on Navigational Subjects, No. 2. (1910)
- No. 229. Table of Meridional Parts for the Terrestrial Spheroid, by Mr. J. W. Atherton, of the Hydrographic Department. (1910)
- No. 230. List of Oceanic Depths received at the Admiralty during the year 1910. (1911)
- No. 231. Report on Admiralty Surveys for the year 1910. Parliamentary Publication. (1911)
- No. 232. Rules to be followed by Naval Assistants and others in correcting charts for N. to M., and minor corrections. (1911)
- † No. 233. Half-yearly Report on Navigational Subjects, No. 3, July, 1911. (1911)
- No. 234. Method of Sweeping for the Discovery of Rocks (making use of the ship). (1911)
- † No. 235. Half-yearly Report on Navigational Subjects, No. 4, December, 1911. (1911)
- * No. 236. Particulars of Spheres, Flinders Bar, Heeling Error Constants, λ_2 , and Values of Constant C, for Compasses of H.M. Ships, 1912. (1912)
- No. 237. Report on Admiralty Surveys for the year 1911. Parliamentary Paper. (1912)
- No. 238. List of Oceanic Depths received at the Admiralty during the year 1911. (1912)
- No. 239. Instructions for the use of Douglas-Schafer Sounding Traveller. (1912)

Title of Publication.

- † No. 240. Half-yearly Summary on subjects connected with Navigation of H.M. Ships, No. 5, July, 1912. (1912)
- No. 241. Datums used on Charts (obtained from the various Hydrographic Offices). (1912)
- No. 242. Table for the Graduation of Surveys and Charts, on the Gnomonic Projection. (1912)
- No. 243. Tables for Determining Geodetic Positions, Latitudes 0° to 65° , together with methods of using co-ordinates. (1912)
- No. 244. Hydrographic Annual for the year 1912, No. 1. (1913)
- No. 245. List of Oceanic Depths received at the Admiralty during the year 1912. (1913)
- † No. 246. Yearly Summary on subjects connected with Navigation of H.M. Ships, No. 6, July, 1913. (1913)
- No. 247. Report on Admiralty Surveys for the year 1912. Parliamentary Paper, Cd. 6851. (1913)
- No. 248. List of Oceanic Depths received at the Admiralty during the year 1913. (1914)
- No. 249. Hydrographic Annual for the year 1913, No. 2. (1914)
- No. 250. Report on Admiralty Surveys for the year 1913. Parliamentary Paper. (1914)
- No. 251. List of Oceanic Depths received at the Admiralty during the year 1914. (1915)
- No. 252. Report on Admiralty Surveys for the year 1914. (1915)

* Transferred to Compass Department.

† Transferred to Navigation Department.

INDEX.

	Page		Page
Angle book, Main - - -	24	CHRONOGRAPHS - - -	9, 12, 17
Arc measurement - - -	87	Care and treatment - - -	17
		Description - - -	17
		Instructions for working - - -	17
		Repairs - - -	9
		Supply - - -	12
Barograph records - - -	27	CHRONOMETERS AND CHRONO-	
BEACONS, SURVEYING, FLOATING—		METER-WATCHES - 12-16, 25.	87
Identification marks - - -	20	Care and treatment - - -	12, 13
Description - - -	21	Comparison book - - -	25
BEARINGS - - -	75, 77	Journal - - -	25
BENCH MARK for reduction of		Packing - - -	15
soundings - - -	18	Repairs - - -	12
BOOKS - - -	23-29	Return to store - - -	12
Admiralty library - - -	29	Supply - - -	12
Account of - - -	29	Transmission - - -	11
Barograph records - - -	27	Chronometric meridian distances -	53
Chronometer comparison - - -	25	Clearing marks and leading lines	57, 66
Chronometer journal - - -	25	Cliffs - - -	67
Current - - -	26	Coastlining - - -	55, 67
Deck - - -	24	Colour, use of, on charts - - -	60-62
Deep sea sounding - - -	24	Compass roses - - -	60
Field - - -	23	Conspicuous objects - - -	57, 67
Height - - -	25	Coral formations - - -	47
Hydrographic, for reference -	27	Courses - - -	75
Account of - - -	28	Current book - - -	26
List of - - -	34	Currents - - -	52, 66, 77
List of, to be forwarded to		Dangers, hidden - - -	56
Hydrographic Department		Dangers, new - - -	47
periodically - - -	36	Data book - - -	24
Main angle - - -	24	Datum mark for soundings - - -	48
Meteorological logs - - -	26	Datums used on charts - - -	94-98
Orthography - - -	26	Deck book - - -	24
Packing of - - -	27	Depths - - -	80
Sounding - - -	23	Distances - - -	80
Special label - - -	26		
Surveying data - - -	24	DRAUGHTSMANSHIP - - -	59-74
Surveying sketch - - -	24	FAIR CHART - - -	59-70
Tidal diagram - - -	26	Breakers - - -	66
Tidal diagram sheets - - -	26	Clearing marks - - -	66
Tide journal - - -	25	Cliffs - - -	67
Tide journal sheets - - -	25	Coastline - - -	67
Tide-pole readings, Record of	26	Colours to be used - - -	60-62
Tides, Register of - - -	26	Compass roses - - -	60
Bottom, nature and specimens of		Conspicuous objects - - -	67
	44, 45, 64, 78		
Breakers - - -	66		

	Page		Page
DRAUGHTSMANSHIP—continued.		FAIR CHART	
FAIR CHART—continued.		(See under Draughtsmanship.)	
Currents - - - - -	66	Fathom contour lines - - -	63
Eddies - - - - -	67	Field books - - - - -	23
Fathom contour lines - - -	63	Floating navigational marks,	
General directions - - -	74	Fixing	57
Geographical terms - - -	69	Forms—	
Graduation - - - - -	59	List of - - - - -	34
Heights - - - - -	67	List to be forwarded to Hydro-	
Hills - - - - -	68	graphic Department periodi-	
Leading lines - - - - -	66	cally - - - - -	36
Lettering, styles of - - -	62		
Memoir - - - - -	70		
Meridians - - - - -	60	GEOGRAPHICAL POSITIONS -	89-93
Mountains - - - - -	68	Arc measurement - - - - -	89
Nomenclature - - - - -	68	Meridians on foreign Govern-	
Observation spots - - -	68	ment charts - - - - -	93
Overfalls - - - - -	67	Tables of latitude and longitude	
Paper, drawing, care of - -	60	89-93	
Paper for - - - - -	60	Time measurement - - - - -	89
River bars - - - - -	66	Values of latitude and longi-	
Scales - - - - -	59	tudes in arc - - - - -	89
Sizes of - - - - -	60	Geographical sequence in writing	
Soundings - - - - -	64	sailing directions - - - - -	75
Plotting - - - - -	64	Geographical terms—	69, 80
Reduction of - - - - -	64	GRADUATION -	59
Nature of bottom - - -	64		
Spires - - - - -	67		
Stations and summits, marking	68	Harbours, Sailing directions for -	79
Tidal streams - - - - -	64	Height book - - - - -	25
Tide-rips - - - - -	67	Height of coastline and rocks off -	56
Title of Fair Chart - - -	70	Heights - - - - -	25, 67, 80
Towers - - - - -	67	Hidden dangers - - - - -	56
Transmission of - - - - -	29	High-water line in British Isles -	56
Trees - - - - -	67		
Views - - - - -	74		
Wooded hillsides, &c. - - -	67		
Writing, mode of - - - - -	62	Identification marks on beacons -	20
PHOTOGRAPHS -	74	India-rubber articles, Preservation	
PLOTTING SHEET -	72	of - - - - -	21
TRACINGS -	73	INSTRUMENTS—HYDROGRAPHIC	7-11
Collector tracing - - - - -	73	Account of - - - - -	11
TRIANGULATION SHEET -	70-72	Care of - - - - -	10
General instructions - - -	71-72	Chronographs - - - - -	9, 12, 17
Ordnance maps - - - - -	73	Demands - - - - -	10
Ordnance triangulation - -	72	Establishment - - - - -	7-9
Paper to be used - - - - -	72	Losses - - - - -	10
Size of - - - - -	71	Packing and transmission - -	11
		Repairs - - - - -	9
		Supply - - - - -	7
		Transmission and packing - -	11
		INSTRUMENTS—METEOROLOGICAL	12
Eddies - - - - -	67		

	Page
Landing places - - -	56, 78
Latitude, Observations for - -	54
Latitude, Tables of - - -	89-93
Lead lines, Marking of - - -	21, 43
Leading lines and clearing marks	57, 66
Lettering, Styles of, on Fair chart	62
Lights and lighthouses - - -	78
Longitude—	
Foreign charts - - -	93
Meridian distances - - -	53-54
Method of obtaining - - -	54
Tables of - - -	89-93
Main angle book - - -	24
Memoir on Fair chart - - -	70
Meridian distances—	
Chronometric - - -	53
Telegraphic - - -	54
Meridians on Fair chart - - -	60
Meridians on foreign Government charts - - -	93
Mess traps - - -	21
Meteorological instruments - - -	12
Meteorological logs - - -	26
Meteorological barograph records -	27
Natural history - - -	58
Nomenclature - - -	68, 80
Observation spots - - -	68
Ordnance maps - - -	73
Ordnance triangulation - - -	72
Original documents - - -	29
Orthography - - -	26, 81-87
Overfalls - - -	66
Paper for Fair charts - - -	60
Paper for triangulation sheets -	72
Photographs - - -	57, 74, 79
Plotting sheet - - -	72
Positions, Method of quoting -	89
Projection of data - - -	57
Proper names - - -	68, 80
Publications of Hydrographic Department - - -	99-114
River bars - - -	66
Rivers - - -	55, 78

	Page
SAILING DIRECTIONS - - -	75-88
Beacons, Shading for - - -	80
Bearings - - -	75, 77
Bottom, Quality of - - -	78
Courses and bearings - - -	75
Currents - - -	77
Depths - - -	80
Distances - - -	80
Flags, Shading for - - -	80
Geographical sequence - - -	75
Geographical terms - - -	80
Harbours - - -	79
Heights - - -	80
Landing places - - -	78
Lights and lighthouses - - -	78
Orthography - - -	81-87
Photographs - - -	79
Proper names - - -	80
Rivers - - -	78
Seaports - - -	79
Shading for flags and beacons -	80
Sketches - - -	79
Tidal streams - - -	77
Tides - - -	77
Writing, Method of - - -	75-80
Scales of charts - - -	59
Seaports - - -	79
Sketches - - -	79
Sketch book - - -	24
SOUNDING MACHINES - - -	19, 20
Defective machines - - -	20
Precautions in securing and handling - - -	19
Supply - - -	19
SOUNDINGS - - -	23, 24, 39-48, 64
Accuracy of - - -	41
Bench marks - - -	48
Books - - -	23, 24
Bottom, Nature and specimens of - - -	41, 45, 64, 78
Calling, Uniform system of -	44
Coral formations - - -	47
Dangers, Hidden - - -	56
Dangers, New, Notice of - -	47
Datums and bench marks - -	48
Deep sea - - -	44
Fair chart, Method of showing on - - -	61
Lead lines, Marking of - - -	21, 43
Reduction of - - -	43, 64
Sweeping - - -	40
Temperature, Deep sea - - -	47
Temperature, Surface - - -	48
Thermometers, Deep sea - -	24, 47
Vigias - - -	46

	Page		Page
Special label - - - -	26	TIDES—continued.	
Spires - - - - -	67	Journal and journal sheets -	25
STATIONERY—		Records of tidal observations -	51
Demand and supply - - -	30	Reducing tidal observations -	49
Forms, List of - - - -	34	Register - - - - -	26
List of articles - - - -	30	Time to be used in recording -	49
Typewriter - - - - -	34	Time measurement - - - -	88
Stations, Marking of, on chart -	68	Title of Fair chart - - - -	70
SURVEY, THE—GENERAL DIRECTIONS -	39-58	Topography - - - - -	56
SURVEYING STORES -	19-22	Towers - - - - -	67
Accounts - - - - -	19	Tracings - - - - -	73
Beacon, surveying, floating -	21, 22	TRIANGULATION SHEET—	
Identification marks on beacons -	20	(See under Draughtsmanship.)	
India-rubber articles, Preservation of - - - - -	21		
Lead lines, Marking of - - -	21	Under-currents - - - - -	52
Supply - - - - -	19		
Wire, Sounding - - - - -	20	VARIATION—	
Sweeping - - - - -	40	Observations for, afloat - -	55
		Observations for, ashore - -	55
Telegraphic meridian distances -	54	Views - - - - -	57, 74
Temperature, Deep sea - - -	47	Vigias - - - - -	46
Temperature, Surface - - - -	48		
Thermometers, Deep sea - - -	24	Wave measurement - - - - -	53
Tidal diagram book and sheets -	26	WIRE, SOUNDING—	
TIDAL STREAMS -	51, 64, 77	Preservation of - - - - -	20
Tide-pole readings - - - - -	26	Writing, Mode of, on Fair chart -	62
Tide-rips - - - - -	67	Writing sailing directions, Method of - - - - -	75-80
TIDES -	25, 26, 48-51, 77		
Books and forms - - - - -	25-26		
Establishments - - - - -	49		